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The New Relation of Research to Selling

INDUSTRIAL research is now generally accepted as the ally of production. Applied to the producer's problem it has enhanced the quality of the product, created new commodities, increased output, diminished waste and augmented profits. This does not imply that research has yet become commonplace in American production, because there are still vast areas to which it has not been adequately applied; but it does mean that research has been adopted as a logical part of the production program of those manufacturers that are conspicuously in the foreground of prosperity and success. As a working tool it has proved its merit.

BUT this is only half the story. Research can become an equally valuable tool in widening the field of consumption, in selling the products of one industry to another. The maintenance and stimulation of consumption is the present problem of the American manufacturer: how to develop policies of merchandising and distribution that will match our incomparable record of production and promote a steady and increasing flow of goods into the channels of consumption. All this is exemplified in the growing tendency to recognize the sales and merchandizing type of mind in selecting the executives of our manufacturing organizations.

THERE is, however, a new note in selling that must be recognized particularly in those industries that are based on science and engineering. It arises from the fact that never before were the demands of the industrial consumer so refined and exacting. With the desire and necessity for increased production efficiency in his own process have come his demand for higher standards in raw materials, for improved processes and better equipment and for new materials of construction. This means that the seller must approach the prospective buyer with some knowledge of the latter's needs and with constructive help. In many cases it means that the manufacturer must actually research the customer's problem, particularly if a new and unproved product is involved.

THE conditions outlined are reciprocal. A manufacturer is at once consumer and producer; consumer of materials and equipment, producer of finished commodities that enter into other industrial processes. Goods flow from industry to industry long before they reach the ultimate consumer. If waste and loss are to be avoided and efficiency promoted each seller must put himself in the buyer's place and be prepared not merely to recommend a product but to prove its worth in terms of the customer's needs. And this will frequently call for research.

RESEARCH on the consumer's problem as an aid to selling is of more than academic importance to manufacturers whose goods and services flow into other industries. The policy already has its successful advocates. In a recent inquiry conducted by *Chem. & Met.* for the purpose of getting examples of unusual service rendered by industrial products, it was a conspicuous fact that only those manufacturers that are committed to a policy of research in both production and distribution were able to respond with pertinent information. Evidently industrial research is a two-edged tool, applicable on one side to improved production and on the other to increased consumption. The manufacturer that fails to apply it in both directions is using it at only fifty per cent efficiency.

Geneva Protocol Should Be Defeated

CHEM. & MET. is opposed to the ratification of the Geneva Protocol because it ignores the truth regarding chemical warfare, because it is likely to entail meddlesome control of our chemical industry, because it is a step toward the abolition of the Chemical Warfare Service, a modest but powerful arm of defense, and because it is a futile gesture which, if soberly considered, will be found without substance.

The so-called "Geneva Protocol of 1925" is part of a proposed international treaty and is designed to prohibit all forms of chemical warfare. It was adopted at a conference in Geneva under the auspices of the League of Nations, the agenda of which was strictly limited to the question of international trade in arms and ammunition. The protocol originated with a member of the American delegation which succeeded in attaching this tail to the kite of the conference report in spite of the protest of other delegates against the consideration of extraneous matters. The protocol is thus an objectionable rider on otherwise acceptable legislation. The entire proposal has been considered by the Committee on Foreign Affairs of the United States Senate and reported favorably to that body for ratification. It is on the calendar for the current session of Congress.

Facts regarding the results of chemical warfare in the past have long been available to open minds. With its humanity or inhumanity we need not be greatly concerned. Humane warfare is anomalous. Nevertheless we have the gratifying truth that in the World War less than 2 per cent of our gas casualities died, whereas about 24 per cent of all other casualties combined failed to survive. And of our non-fatal gas casualties 98 per cent have recovered and returned to useful civil life unencumbered by the crippling effects that every other weapon of offense caused in great numbers.

A probable sequel to the ratification of the protocol will be an attempt to supervise the production of chemicals that enter into gas warfare. The mixed commission of the League of Nations charged with the study of industrial units in connection with world disarmament recently recommended strict control by the League of the world chemical industry in order to eliminate the possibilitiy of future gas warfare. It is difficult to imagine a less welcome or more unacceptable proposal, but apparently it is made in all seriousness.

The fallacy of the argument against chemical warfare is matched only by the futility of the proposal to prohibit it. As the most modern arm of the military establishment it is suffering the fate of all its predecessors in becoming a target of criticism. But has any nation ever restricted the inventive genius of its people in devising improved means of offense or defense? And shall we now suffer ourselves to be deprived of such means through ill-considered legislation sponsored by uninformed enthusiasts? And if the nations should accept the prohibition, will any nation thereafter fighting for its life refuse in its extremity to avail itself of the prohibited arm? As a matter of fact, wasn't it under just these circumstances that the use of gas was begun in the World War regardless of the Hague Convention? The idea of prohibiting chemical warfare is conceived in an atmosphere of illusion, and the policy for the United States to pursue is to support the Chemical Warfare Service and defeat the protocol. As an effective means to this end we suggest that representatives of the chemical industry write convincingly to their Senators who are now beginning to gather in Washington.

A Patent Bill That Should Be Vetoed

ON THE last day of the last session of Congress, July 3, 1926, S. 4480, relating to certain patents, was passed by the House but not in time to be signed by the Speaker and Vice-President and forwarded to the President. This bill has a vital interest to every owner of a United States patent; and in view of the fact that it can be signed and sent to the President at the beginning of the next session of Congress it is important that steps should be taken to insure its veto.

The bill provides in brief that the life of a patent issued to one who served in the armed forces of the United States during the World War may be extended by a period equal to three times the length of that service. It requires no clairvoyance to foresee the endless turmoil and confusion that will result if this bill becomes law. No one knows which patentees served with the armed forces of the United States during the late war, and consequently no one can foretell what patent might be extended until it suddenly rises like a jack-in-the-box to plague him. The bill fairly invites an attitude of suspicion. Ostensibly it seeks to obtain a special favor for all veterans, but one wonders whether the real motive may not be to prolong the life of a particular patent whose inventor happened to serve in the Army or Navy and who seeks to conceal his personal interest in a generous gesture to all who served with him. The proposal is completely lacking in merit and portends nothing but trouble for American industry which will be quite justified in using all legitimate means to see that the bill is vetoed by the President.

Maintain the Quality of the Federal Judiciary

ON DECEMBER 9 the bill to increase the salaries of Federal judges comes before the House of Representatives for final vote. Having already passed the Senate, there is good prospect that the bill will become a law during this session of Congress; but unless it has the vigorous support of industry, there is equal prospect that action may be delayed and the measure lost. Every engineer and every company in the chemical engineering industries should immediately urge upon Congress the importance of maintaining the high quality of our Federal judiciary.

The unjustness of the present antiquated scale of salaries is widely recognized. Unless the relief now promised becomes effective shortly, a serious breakdown in the Federal judiciary machinery is actually threatening. And this comes at a time when the growing complexity of our industrial life has crowded the courts with complicated litigation calling for the highest type of judicial understanding and decision.

The American Engineering Council and its constituent societies have given unqualified support to the Graham bill. A final effort is now essential if it is to become a law. Engineers and industry in general should respond to this call for public service.

Wanted—A Follow-Up On Management Week

MANAGEMENT trotted out into the ring and went through its paces again during the annual recurrence of "Management Week" in October. Over 200 meetings were held in almost half that many towns and, for five days at least, the minds of many engineers dwelt on the need for good management practice.

We would not decry anything that serves to aid the cause of better management. Certainly there is room in the chemical engineering industries, as in industry at large, for improvement in this sphere. To throw the full glare of the spotlight of public attention on the subject for even a week cannot fail to do some good.

But there are certain plant executives who, like the man who faithfully attends church each Sunday only to put religion from his thought and action on weekdays, will concentrate on improved management when it is focused to their attention during "Management Week" but neglect it during the remainder of the year. Approval will be given to the views then put forth, and perhaps good resolutions will be made to give improved management the attention it deserves. But in the rush of business throughout the ensuing year the subject is too often forgotten.

What is needed, then, is some way to keep the improvement of management always before the industrial executive. One week each year is without doubt sufficient time to concentrate on the forward steps that should be taken. But the only way in which these steps will be accomplished is little by little, as the opportunity offers. And if this end is to be reached some follow-up will have to be devised to keep the subject constantly before those who might otherwise forget it. A large share of this responsibility undoubtedly falls upon the technical, trade and business magazines that reach regularly specific groups of readers. Another share can well be considered by the agencies promoting the annual emphasis on the subject.

A Quarter Century of Distinguished Service

IN 1901 the Bureau of Standards was founded. On December 4 of this year it will hold open house in celebration of its twenty-fifth anniversary. And it may well hold a celebration, for the past quarter century has been one of great achievement and of distinguished service to this country.

In the founding of the Bureau of Standards it is evident that there was a large vision of potential service to science and to industry, for the organic act establishing it described its functions broadly. But it is hardly possible that at that time anyone could have foreseen the present establishment, the largest bureau of scientific and technologic research in the world. It is hard to find words adequate to express the growth which has taken place, from a meager half dozen workers to the present establishment which spends about two million dollars per year on research and technical service to industry.

In the bureau are combined two rather distinct lines of activity, a study of scientific fundamentals and technologic development for many branches of industry. Only the exceptional capacity for leadership which has always characterized the heads of the bureau's work could have thus wedded pure science with industrial research and produced a harmonious and numerous family of achievements.

The bureau has from the first believed that accuracy and unbiased truth were primary requisites for all of its activities. Never has it been willing to be hastened at a pace that would jeopardize precision, nor has it been willing to be swayed by any influence other than all of the facts. Its standing as an unchallenged technical supreme court is therefore widely recognized and is truly well deserved.

In earlier years the growth of the bureau took place almost altogether through increases in appropriation by Congress. With the shrinking value of the dollar and the compulsory retrenchment to secure government economy, it first appeared that the work of the bureau must be curtailed sharply. Industry did not look with favor upon such a result and sought means to prevent it. As a result a scheme of co-operative research was developed wherein industry supplies part of the personnel and some of the facilities for work. That industry appreciates this opportunity and seeks at all times to encourage the bureau is evident from the recent estimates that industry itself is now spending annually through the bureau nearly a half million dollars.

Not all interested can attend the open house celebration on December 4. Nor will all find opportunity to send a message of congratulation to the director by that date. But whether spoken in person or by written communication the congratulations of industry and of scientific men will be unanimous. May the next quarter century be equally successful—we cannot wish more for the bureau than that.

Avoiding Power Waste From Bearing Friction

WASTE IN INDUSTRY was again the topic of "Management Week." The variety of waste discussed was that which can be eliminated solely by co-operative action and did not include those industrial wastes, the responsibility for which and the avoidance of which rest solely on the individual plant. This latter class of waste, however, is often as much a burden on the individual plant as the more widespread variety, and a thorough study of plant conditions that will uncover and lead to the elimination of such waste is a profitable undertaking.

One of the most frequently encountered but least heeded of all plant wastes is the avoidable waste of power. Such waste may occur in a number of different ways but the least noticed and yet most serious form is loss due to needless friction. Such loss is generally caused by incorrectly designed bearings, for it is in the bearings of rotating machinery where friction most usually occurs in modern power driven equipment.

That such wastes are often of great importance is shown by records of plants that have cut down their horsepower requirements by one-third to one-half. This has been accomplished by making a careful survey of all the bearings in the plant—machine, shafting and other bearings—and then replacing any bearings that were found not operating at high efficiency with the most efficient new bearings of suitable design obtainable.

Such a proceeding is particularly fruitful when applied to the bearings of line shafts and other power transmitting shafts. With such equipment the most careful maintenance is often inadequate to keep the

shaft in perfect alignment; and shafts that are out of alignment develop much friction and hence power loss at the bearings. The use of well-designed shaft hangers with self-aligning bearings has often resulted in such a reduction in the amount of power required merely to turn the shaft over that 25 per cent more useful work could be obtained from the motor. And cases where such increase has amounted to 50 per cent are not unusual.

Of course, there are plants where it is cheaper to waste power than to incur the capital investment that would be necessary completely to modernize the bearing equipment. But investigation in such plants will often show where a small investment will bring large savings. And power costs enter so largely into the total cost of modern manufacturing methods that any power saving that can be made is sure to be reflected in the competitive position of the plant.

Our Next Step in The Nitrogen Cycle

NITROGEN still holds the center of the stage in European chemical engineering developments but the early sensational discussions and publicity which followed the war are now giving way to amazingly rapid commercial developments in plants in many countries. Curiously enough much of the progress is being made in small plants in Italy, France and England, although the giant I.G. organization in Germany still is the most conspicuous factor in actual production. It, however, has not been able (or perhaps has not found it profitable) to change its plants in accordance with the latest developments. It is continuing to use much of the war-time equipment on very nearly the identical operating basis for which it was originally built.

Outside of Germany the Casale-Claude rivalry focuses attention on these two outstanding ammonia processes. At present it would seem that the Italian has the advantage for it has traveled farther industrially, yet many observers believe that the Claude holds the greater promise for the future. Some of its basic advantages result from the use of higher pressures (900 to 1,000 atmospheres as compared with 600 to 750 atmospheres for the Casale) and from its simpler operation and construction. The series of catalyst chambers gives high conversion with a single pass through the system and it can be operated on a continuous basis.

The Casale process, directed by the Swiss company "Ammonia Casale S. A." from its official headquarters at Lugano-Massagno, has become one of the most formidable factors in the nitrogen situation. With nine plants in operation in Italy, France, Belgium, Japan, Spain, Switzerland and the United States, it now has to its credit a total operating capacity of 150 net tons of anhydrous ammonia per day. In addition, potential capacity of over 500 tons per day is contracted for and these plants are planned or in process of construction. One important project in the latter class is the French Government's plant at Toulouse (Usine Governmental pour Fixation de l'Azote) for which an ultimate capacity of 180 tons has been planned; but this project is still suffering many delays. It is significant that the Japanese firm now operating four 7½-ton units at Nobeoka is building four 8-ton units and is very recently reported to have contracted for several additional units, some of 20 tons capacity, that will add 160 tons per day to its total output.

Since ammonia synthesis has passed the experimental stage, the problems of marketing and ammonia utilization are receiving major attention. These synthetic products, not content with having practically driven all Chilean nitrate out of the European fertilizer industry, are now seeking to replace it for the manufacture of nitric acid. Marked progress has been made in ammonia oxidation and today nitric acid from this source is an active and successful competitor with nitric acid from Chilean nitrate.

Improved absorption methods are being used, among them the Toniolo system in which the absorption efficiency is so increased by the use of refrigeration that it is no longer necessary to use caustic soda in the final clean-up of the gases. This does away entirely with the necessity for producing the bothersome byproduct, sodium nitrite. The engineers responsible for this improvement have also developed a unique scheme of neutralizing ammonia with nitric acid to produce a finely crystalline ammonium nitrate that is being mixed with an equal amount of gypsum and sold to the farmer in competition with Chilean nitrate. In this scheme the hot concentrated liquors containing 90 to 95 per cent of ammonium nitrate are run into a sort of dough mixer and after about two hours of constant stirring during which a blast of cold air is blown continuously over the crystallizing mass, the product is obtained as an even, fine-grained, crystalline powder.

And so the air-nitrogen industry is pushing steadily ahead in its commercial as well as technical aspects. In the United States this progress may not have been as conspicuous, but it appears to have been almost as satisfactory, at least in a technical sense. Synthetic nitrogen does not in the United States, as it does in Europe, dominate both the fertilizer and the nitric-acid industries. But as American development in ammonia oxidation is progressing it is increasingly apparent that the distress of the Chilean nitrate producers is due to become still more acute. In this country we have not yet reached the nitrate nitrogen stage of the nitrogen cycle but there is growing evidence that we are definitely and rapidly on the way.

Why Not American Propaganda Also?

LATELY, the British Sulphate of Ammonia Federation has been actively telling of the advantages of this fertilizer constituent. The Chilean nitrate producers have aggressively propagandized the world on the merits of nitrate for fertilizers. The American nitrogen producers have, on the other hand, simply put their product into bags and, figuratively speaking, set them in a row before the farmer without any particular inducement to him to buy. In fact, some of the bags were quite as conspicuously filled with acid holes as with ammonium sulphate; and the salt was often rusty or otherwise discolored, making it quite an unattractive product.

All this was well enough when there was an excess of demand for these fertilizer constituents above the available domestic supplies. Now there is a surplus supply and a world-wide intensive competition for nitrogen markets. Furthermore, the American farmer is not as prosperous as he should be; and the American consumption of fertilizers is, therefore, not growing nearly as rapidly as the American supply of ammonium sulphate.

The first six months' production of ammonium sulphate this year as compared with last shows approximately a 12 per cent increase. This should be the final argument needed to convince producers of the necessity for organized sales propaganda. Such concerted effort among United States users by United States manufacturers should start *now*.

Everything indicates that the ammonium sulphate which is being produced is in every way as satisfactory a fertilizer constituent for practically all uses as is Chilean nitrate. The farmer can buy this sulphate at present prices for about three-quarters as much as equivalent nitrate nitrogen would cost him. The only thing required is to convince the farmer that the results from fertilization with ammonium sulphate are as good as from fertilization with Chilean nitrate. Federal, State, and college agronomists can furnish data that will prove this for most conditions of soil, plant, and climate.

Sound economic considerations demand such substitution, but it will not come about unless adequate sales effort is made. It is, therefore, strictly up to the producers as to whether they will realize upon this market and stabilize prices where they belong, or whether they will continue to produce increasing quantities of ammonia with constantly decreasing market price.

Group Research as An Industrial Aid

THE IMPORTANCE of research to industry is a song so often sung that a repetition of its chorus suggests almost the monotony of the recent embargo on bananas. Nevertheless the acceptance of a far-sighted research policy by one of our oldest industries, and one which in times past has been deemed short-sighted, is an especially refreshing thought.

Added to this is the policy of open door and close co-operation even between competing organizations and between those comprising the technical staffs of these companies. Thus the gas industry, recognizing the many advantages to be gained by co-operative conduct of investigations and research, has pooled its interests in the American Gas Association now establishing its new laboratory.

Recognizing that some of the problems pertaining to the industry are sectional in nature and depend somewhat upon local conditions, the California gas producers have established the California Gas Research Council for the study of problems peculiar to the industry on the Pacific Coast. This activity has been further augmented through the establishment of a research fellowship by the Pacific Coast Gas Association, an organization of producers and operators.

The Coast industry in 1925 produced and marketed one hundred billion cubic feet of gas. To make and distribute this quantity of gas, equipment valued at $235,000,000 was used. Considering these facts and that the use of gas is increasing faster in this section of the country than in any other, although it has little in the way of coal resources, it is evident that the problems of the gas man here are unique and diverse. He must build his industry without recourse to methods and procedures used before. Much has been accomplished so far. The value of the equipment, its newness and the amount of product are measures of this. For the future, the co-operative policy which has thus far paid so well, is to be maintained.

Rôle of Science in Waste Elimination

CONSTANT repetition has tended to dull the advertising appeal of the "Elimination of Waste" slogan and in many quarters of industry the phrase has become a rather distasteful reminder of propaganda. Too often, unfortunately, it carried the implication of individual and willful wastes rather than pointing the way to the advantages accruing from the improvement of even the best of present-day practice. Nevertheless the great national effort inaugurated by the Department of Commerce five years ago has gradually penetrated every department of industry and has become so complex that its true economic significance is not easily evaluated. Secretary Hoover's annual report performs a real service, therefore, as a reminder of the original program, as a record of the unique results already obtained and as a guide to future accomplishment.

The program outlined by the Department at the beginning of the undertaking set up ten major directions in which improved practice should be encouraged. Among these it may be recalled were the need for co-ordinated transportation, for more efficient utilization of water resources, for the more general electrification of industries and for the reduction of the booms and slumps of the business cycle as well as the variations in employment caused by seasonal influences or industrial strife. It was likewise recognized that the development of pure and applied science was the best foundation for better processes and sounder methods in production while similar scientific study of marketing principles was needed to put distribution on an equal plane of efficiency.

What the country as a whole accomplished in these directions cannot be measured with the usual yardsticks but Secretary Hoover points to a relation between wages and prices which is extremely significant in that connection. Since 1920 union wage rates have increased from 199 (based on 100 for 1913) to 238 for August, 1926, and during the same time the average wholesale prices of all commodities have fallen from 226 to 150. That this remarkable condition is peculiar to the United States is easily shown by a comparison with similar indexes for Great Britain where wages decreased from 256 to 175 rather than increased during this same period. British wholesale prices of all commodities, in the meantime, decreased from 283 in 1920 to 166 in 1925 when measured on the 1913 basis.

But all that has so far been accomplished has come largely from improvement in existing practice. Future progress, the report aptly declares, depends in a large measure upon "the increase and diffusion of knowledge among men." It is not simply a question of applying present-day knowledge. "We must add to that knowledge through research in pure science. The improvement of some machine or process is of great value to the world, but the discovery of a law of nature, applicable in thousands of instances and forming a permanent and ever-available addition to knowledge is a far greater advance." A step in that direction is to be seen in the work of the committee of industrial leaders who are now endeavoring to obtain a fund of $10,000,000 to $20,000,000 as an endowment of research in science. Other agencies are working toward the same end and if plans thus laid prove productive we may expect to find new science and new knowledge playing prominent rôles in the waste elimination program of the future.

Charles Raymond Downs Receives Grasselli Medal

Awarded for notable paper on catalytic oxidation of organic compounds in the vapor phase

PRESENTATION last spring before the American Section of the Society of Chemical Industry of a scholarly paper entitled "Catalytic Oxidation of Organic Compounds in the Vapor Phase" (see *Chem. & Met.*, p. 295, May, 1926) won for Dr. Charles R. Downs, chemical engineer of New York City, the 1926 award of the Grasselli Medal. Established in 1919 by the Grasselli Chemical Co. of Cleveland, Ohio, the Grasselli medal is awarded each year for the scientific paper, which in the opinion of the medal committee, offers the most useful suggestions in applied chemistry. Dr. Downs, whose work with J. M. Weiss on the oxidation of coal-tar hydrocarbons to produce malic, maleic and fumaric acids has opened up a new field in synthetic organic chemical industry, is the fifth to have been chosen for the honor.

Dr. Charles R. Downs

The medal was presented November 5 at the joint meeting in New York City of the American sections of the Society of Chemical Industry and Societé de Chimie Industrielle and the New York sections of the American Chemical Society and the American Electrochemical Society. The award was made by Prof. Treat B. Johnson of Yale University, former townsman, teacher and associate of the medalist. Dr. Downs, he declared, was the product of our American educational system—"a representative of the group of young American chemists that has been able to acquire a sound fundamental training in the chemical profession in our own country and to lay a secure foundation for further work without being inoculated with the influence or teaching of foreign institutions."

Born March 17, 1888, in New Haven, Conn., Dr. Downs received his early training in the public schools of that city. Entering Yale in 1906 he completed a 3-year course in the Sheffield Scientific School, receiving the Ph.B. degree in 1909. Continuing in the graduate school he was awarded his Ph.D. degree in 1912; his doctorate thesis was a study of "Water-Gas Tar, Its Composition and Commercial Possibilities." Following this early interest in coal-tar technology, Dr. Downs became associated with the Barrett Co., serving for 10 years in the research department, first as assistant and later as chief chemist. In 1922-1923 Dr. Downs was in charge of development work with the National Aniline & Chemical Co., resigning to become a partner in the firm of Weiss & Downs, consulting chemical engineers, of New York City.

Responding to Professor Johnson's presentation of the medal, Dr. Downs read a paper entitled "Some Speculations in Catalytic Oxidation Reactions." Admittedly, however, his speculations were of the conservative, scientific sort slowly developed as the result of hard work—physical chemistry in the athletic rather than philosophical sense. "It is admitted," he said, "that many organic compounds can now be made more cheaply by catalytic methods than by the older chemical processes, and the future of catalysis is bright but the art as far as the vapor-phase oxidation of organic compounds is concerned is still in the empirical stage. A new process is quite often discovered by what might be called accident, for want of a better term, plus training and the ability to observe. It is then by careful empirical experiments improved and reduced to successful accomplishment, and then too often a scientific man forgets the chronological sequence of events and gives the impression that the theory preceded the practice. The importance of abstract theory has become overemphasized and honest hard labor loses scientific caste. The broadcast speculations of scientific men should be less spectacular, otherwise the world will await revolution in practice rather than be satisfied with evolution. which is the safe and sane path from which changes take place that are ultimately revolutionary in effect."

Some brilliantly speculative hypotheses were presented in a short talk by Dean Gerald L. Wendt of Pennsylvania State College. Dr. Wendt, defending the philosophical viewpoint, pointed out that the subject of catalysis must be attacked from the basis of theoretical knowledge and that energy considerations rather than purely chemical relations must be studied, since the phenomenon of activation is always involved in catalysis. Recent work has made clear that activation, in turn, always involves either the removal or displacement of one or more electrons from the atom. These electron displacements are known to be basic factors in fluorescence, phosphorescence and perhaps in the photochemical effects of light on a sensitized plate. The "activator" in these cases is really the atom, which by being ionized causes the entire effect. Dr. Wendt, noting the similarity to many forms of catalysis, concludes that the actual mechanism of catalysis is most likely an effect dependent upon electron displacements in the molecules of the "promoters," "activators" and "accelerators" as well as in the molecules of the catalysts themselves.

Chemical Engineering Advances Made By Gas Industry

Technical sessions at American Gas Association convention discuss carbonization, research, drying of gas and utilization problems

Editorial Staff Report

PROBLEMS of direct chemical engineering interest occupied the bulk of the time at the technical sessions of the American Gas Association convention in Atlantic City, October 11 to 14. The outstanding technical paper of these meetings was undoubtedly that by F. W. Sperr, Director of Research, The Koppers Co., who spoke on "Dehydration of Manufactured Gas." An extended presentation of Mr. Sperr's study will be made in a later issue of *Chem. & Met.*, because the fundamentals which he considers for manufactured gas are quite as directly applicable in numerous other chemical engineering problems.

The presentation of committee reports was made in a novel manner at these sessions. Each of the major technical committees selected one of its members to give a résumé and critical analysis of the committee report. This presentation was made as the opinion of the individual chosen, in order that it might not appear that the committee as a whole or the Association was taking an official stand on what might be disputed points. A second advantage gained was the feeling on the part of all individuals attending the sessions that any criticism which they wished to offer would not be taken as a criticism of the committee as a whole, but rather as a simple difference of opinion between themselves and the speaker who opened the discussion. Apparently, the results of this scheme are decidedly good for a vigorous discussion developed in connection with practically all of the committee work that resulted in bringing out many valuable opinions and constructive suggestions.

Chemical Development Summarized

The Chemical Committee of the Association during the past year undertook to review the present state of our knowledge on approximately twenty important phases of the gas industry. The resulting chapters of the report are to be published later by the Association in what might well be termed a compendium of present knowledge of gas chemistry—and of present ignorance in that field.

To summarize briefly for the convention this material, Dr. A. C. Fieldner, chairman of the committee, presented a paper on "Recent progress in science in relation to the gas industry." He emphasized particularly our modern views as to the chemistry of coal, recent developments of the petroleum industry affecting gas making, new processes for enrichment of gas with methane from blue gas or by catalytic enrichment with motor fuel production simultaneously, the Bergius process for liquefaction of coal, and the problems of synthetic ammonia and alcohol as affecting by-product coke oven activities.

Some outstanding research problems which should command the attention of the Association were summarized by Dr. Fieldner as follows:

"1. The constitution of coal in relation to its carbonization and the products obtained.

"2. The physical and chemical properties of coke in relation to its manufacture and use.

"3. The production of hydrocarbons and alcohols from water gas.

"4. The production of cheaper hydrogen and oxygen.

"5. The development of heat and corrosion-resisting metals.

"6. Corrosion of metals.

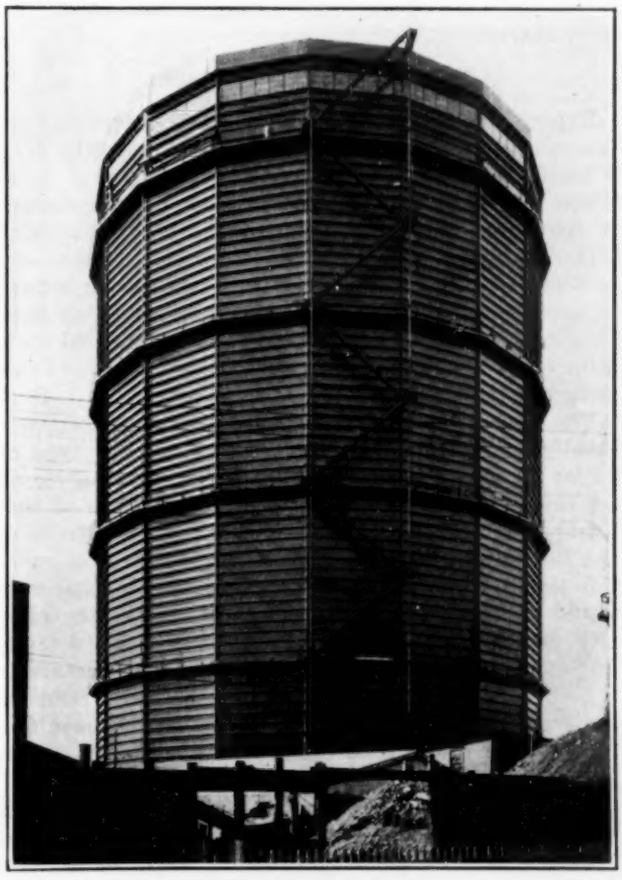

Fig. 1—Waterless Gas Holder
This type of holder has been erected at a number of plants and, as experience in its use accumulates, is coming to be recognized as successful

Fig. 2—High Pressure Gas Holder
The Hortonsphere, first used for storage purposes in the petroleum field, is being successfully employed as a holder for manufactured gas.

"7. The requirements of gas-works refractories.

"8. The rate of heat transfer in tubular condensers from a gas containing water and tar to a metal surface under such conditions that a portion of these substances condense.

"9. Gas purification.

"10. Influence of gas composition on combustion and flame characteristics."

The Waterless Gas Holder

Experience in operating four gas holders of the "waterless" type furnished the basis for a paper by J. G. O'Keeffe, Public Service Electric and Gas Co. of N. J. It was pointed out that the substantially greater amount of operating labor thus far required on this type of holder is largely due to its novelty. The erectors and present users who participated in the discussion seemed to agree that this disadvantage is rapidly being done away with and that no allowance for such unusual operating expense need be anticipated for any holders of this design in the future.

The interest in this subject among gas engineers was greatly increased by the fact that a similar type of holder in Posen (Germany) had been wrecked by an explosion. The faulty features of construction of that European installation were explained by Mr. Bruce of the Bartlett-Hayward Company, American erectors of this type. It was pointed out why such an occurrence would probably never be repeated in view of the superior engineering designs which had been consistently employed in the United States. The single instance in the U. S. in which ice or frost troubles had been experienced was explained by Mr. Bruce and the modifications in the piston shoe construction to prevent recurrence were described.

It was evident from the discussion at the meeting that a large number of gas companies are considering this new type of holder for future increases in their gas storage capacity. Such extensions are reported to be under construction in a large number of cities already. Nothing in the discussion indicated any reason why such holder could not be utilized for any industrial gas, except perhaps hydrogen.

Perfecting Service and Safety

Speaking as "one not associated with the industry," Dr. George K. Burgess, Director of the Bureau of Standards, presented his views as to outstanding trends in the relation of the gas industry to public welfare. He stressed the pioneering achievements of early gas men and congratulated the industry upon its splendid record in continuity of service, pointing out that "many companies have never had a general interruption of service during their entire existence of fifty or more years."

Doctor Burgess emphasized the competitive relationship of gas to other energy sources and decried the persistence among non-progressive members of the industry in "the traditional belief—that the available market, while somewhat subject to expansion by sales activity, is not appreciably affected by the cost or character of the service rendered." He stressed the fact that the best gas is "the gas that can be sold to the customer at the lowest cost per B.t.u. and no other factor except cost may be seriously considered." He recognized, however, that uniformity in supply is an essential element by pointing out the fundamental problem of importance—the determination of how far extra cost can be justified in order to approach more closely to perfect service.

This discussion was directed particularly to the problem of increasing industrial, rather than household, uses of gas. And the importance of the present program of appliance testing and development was strongly stressed. Research as an integral element in this progress was urged. Such research is as much the duty of the gas company as of the appliance manufacturer, as both are vitally concerned.

Bituminous Coal for Water Gas Generation

The use of bituminous coal as a generator fuel was reported on by a sub-committee of the water gas committee, under the chairmanship of W. J. Murdock, one of the pioneers in this field. The committee concludes that: "The use of bituminous coal as generator fuel has passed the experimental stage and we believe that every operator in the country can take advantage of the savings to be effected by the use of this fuel and need have no fear of encountering unheard of difficulties, as these have most all been met and surmounted."

In order to aid in attaining these obvious advantages the committee has prepared a set of instruction for operation of a carburetted water gas set with bituminous coal. These instructions emphasize the importance of selecting a properly sized lump of coal which does not integrate in the generator. The handling of such fuel should be such as to avoid breaking. The ash and moisture content should be low, but "the fusion point of the ash does not seem to be very important." Directions are given by the committee for starting up and operation, with explanations as to the reasons underlying each part of the operating cycle.

For small sets, up to 6 ft. in diameter, gas-making capacity is not reduced by use of bituminous coal; but above this diameter the use of a cross-wall or pier process is recommended. It is concluded that the oil results with bituminous coal should show about the same efficiency as when coke is used. The report includes a theoretical discussion as to the coal gas formed and

that retained in the mixture. Typical operating results and gas analysis are given.

Waste Heat Boilers

The large increase in number of companies using waste-heat boilers on water-gas equipment has permitted a sub-committee dealing with the subject to summarize the reported economies. The results which are given in great detail for approximately twenty-five plants appear to indicate the following conclusions: Saving in cost of coal alone ranges from 0.7 to 1.8 cents per thousand feet of gas made when waste-heat boilers are used on the blast gas only. The saving in labor and maintenance on other boilers increases the saving in some cases to as much as 4.4 cents per M.; but, in general, the saving is under 2 cents per M. When the waste-heat boiler is used on both blast gas and illuminating gas the savings are substantially greater than with blast gas waste-heat boilers alone. Engineers who contemplate the use of waste-heat boiler equipment on any variety of kiln or furnace can profitably procure and study this chapter from the Water Gas committee's report.

Those interested in steam regenerators will find similar valuable information on that subject in a sub-committee report prepared under the chairmanship of R. E. Kruger. One of the most important precautions noted in this latter report is the necessity for inlet and outlet connections of ample size because of the very low differentials in pressures which are permissible. It is notable that 90 to 96 per cent steam recovery from properly insulated regenerators is practicable in the committee's opinion. Low cost (from $3,500 to $18,000) and simplicity in operation are noted by the committee.

Advantages of Oil Gas

The report of the sub-committee on oil gas, E. L. Hall, chairman, came in for lively discussion because of the difference of opinion which developed as to the investment cost which should be considered as typical for oil gas and carburetted water gas plants. The sub-committee had presented the chart in Fig. 3, showing the relative production cost per M for three kinds of gas. The validity of the conclusions which can be drawn from this chart depends on whether or not the assumed capital costs per M are correct. The figures assumed were for oil gas, $45; for carburetted water gas, $50; and for coal gas, $400 of investment per M of gas made on the maximum day. Several of the engineers discussing this report claimed that the carburetted water gas investment figures should be approximately $200 and that the oil gas investment would probably be comparable with this latter sum.

The committee pointed out that gases of low specific gravity, if uniform in this characteristic, have a very great advantage in distribution. Gases of high heating value are also at an advantage in distribution. The committee summarized their comparison as follows: "As applied to distribution and utilization, carburetted water gas with a heating value of 450 B.t.u. and 0.7 specific gravity will require a system with 70 per cent greater capacity than oil gas or coal gas of 570 B.t.u. heating value and 0.4 specific gravity."

Measuring Oil Efficiencies

Radical difference of opinion still persists as to the proper method of calculating the efficiency of oil use in a carburetted water gas machine. A sub-committee under the chairmanship of L. J. Willien, reported on this subject in an effort to bring about a uniform practice. This committee pointed out that the so-called "Pacific Coast method" with some modifications which were developed by the engineers of the Providence Gas Company was probably the most promising procedure. The same process can be used in calculating oil efficiency in oil-gas making; and there, as in water gas, it has a great advantage in permitting a dissecting of the operation of the machine to determine just what is taking place at each step of the process.

The method of calculation, which is explained and illustrated fully in the committee report, is based upon a complete gas analysis. This fact has subjected the method to some criticism; but the committee concludes that anyone competent to operate a calorimeter can learn to use the necessary gas-analysis apparatus and, therefore, that the method should be generally applicable. It is pointed out, however, that this procedure requires further investigation and a modification, which has not yet been worked out, if it is to be used on water gas made from bituminous coal with a blow-run cycle.

Getting Values from Gas Works Effluent and Waste

The disposal of effluent oil and waste materials which cannot be discharged from a water-gas plant into a stream was considered in a recommendation of F. W. Steere. This proposal assumes that a decanter of suitable size separates the oil and scums from the clear water. This decanted oil, it is proposed, should be

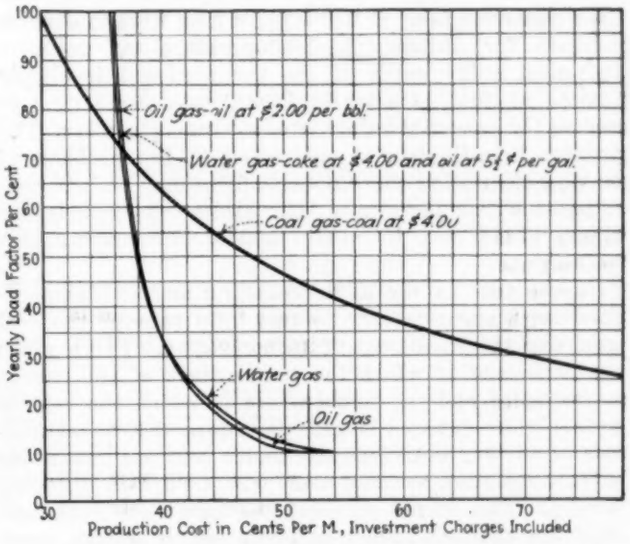

Fig. 3—Relative Production Cost per M. for Oil Gas, Water Gas and Coal Gas

pumped to the water-gas machine and sprayed into the top of superheater during the back-run part of the cycle. Several months' trial of this system indicates completely successful operation. It has been found that the effluent is available in approximately the right amount completely to replace the process steam ordinarily used during this part of the gas-making cycle. It is believed by this contributor that both coal gas and water gas effluent can be effectively disposed of in this way, assuming that the total volume is not in excess of the water-gas machine capacity.

Studies of Tar from a Commercial Low Temperature Retort

Fractionation of tars and acids, production of condensation products and neutral oils investigated

By Harry A. Curtis and H. A. Beekhuis
Department of Chemistry, Yale University, New Haven, Conn.

TAR obtained when bituminous coal is subjected to low-temperature carbonization is a raw material which will presently become available in large quantities, and its profitable utilization will lower the price at which the solid residual of carbonization must be sold. Such low-temperature tar and tar distillates as have been produced in this country in recent years have been sold in the markets for the corresponding coke-oven and gas-house products, and since the trade specifications refer to these usual types of tars, the low-temperature products have been sold under a handicap in no wise related to their potential values. In estimating the revenue from byproducts in a low-temperature carbonization project it is correct for present conditions to consider low-temperature tar as being of no more value than coke-oven tar, or even of somewhat less value than this. But looking ahead to a time when low-temperature tar can be had in quantity, it is difficult to believe that it will be of no more value than coke-oven tar. It has taken a long time to develop markets for ordinary high-temperature tar products and even today much of the tar produced is simply burned as fuel. Obviously it will take some time to realize the potential values of low-temperature tar. The present investigation is addressed to the problem of making clear what those potentialities may be, and contributes a few facts in a field where considerable has already been done by others and much more remains to be done.

In considering the data regarding any low-temperature tar it is necessary to take into account the coal used and the conditions of carbonization. For a given coal, the rate at which the temperature of the charge is increased and the temperature to which the volatile products are exposed largely determine the characteristics of the tar obtained, but under constant conditions of carbonization various coals will yield tars differing widely. This is not so much the case with high-temperature carbonization where the initial volatile products are so much altered by subsequent cracking during prolonged heating at high temperatures, and initial differences thereby largely eliminated.

The coal used in the present case and the conditions of carbonization were as follows:

Coal from Monogah Mine, Consolidation Coal Co., W. Va.		
Moisture	3.0	..
Volatile combustible matter	36.0	37
Fixed carbon	50.5	52
Ash	10.5	11
	100%	100%
Sulphur		1.08

Conditions of Carbonization	
In shell of retort	1100 to 1200°F.
In gas, feed end	500 to 650°F.
In gas, discharge end	750 to 950°F.
Speed of paddle rotation	2 r.p.m.
Volatile left in semi-coke	15 per cent

The coal was carbonized in a Carbocoal process commercial size retort designed by C. V. McIntire and operated at Fairmont, W. Va. This retort was much like the one described by Curtis and Geldard in *Chem. & Met.*, 28, 171 (1923). The tar used in an investigation by Morgan and Soule, *Chem. & Met.*, 26, 923, 927, 1025 (1922), was produced in the retort described in that paper, and since the coal used was also similar in the two cases, the data of the present investigation supplement those of Morgan and Soule.

It should be mentioned here that in comparing low-temperature and high-temperature tars Morgan and Soule chose to make the percentage of tar oils distilling over between various temperatures a basis of comparison. For commercial purposes the comparison is more significant if made on the basis of the amounts of distillates which leave pitch residues of the same melting point. Compared in the latter way the two classes of tars show greater divergence than indicated by Morgan and Soule.

Using a small cylindrical copper still such as described by Weiss in *Ind. Eng. Chem.*, 10, 732, 817, 911, 1006 (1918), the relation of volume distilled to melting point of the residual pitch, to the free carbon in the pitch, and to the specific gravity of the fractions distilled was determined. Results of these determinations are given in Fig. 1. For all later parts of the investigation, the tar was distilled first in a 16-gal. still built of a short section of steel pipe and mounted horizontally in a gas-fired furnace.

Fractional Distillation of Tar Oils and Tar Acids

It is well known that the so-called "tar acid fraction" of low-temperature tar is a complex mixture of cresols, xylenols, etc., and probably some dihydroxybenzols or higher homologues. Fractionation of this mixture effects only a very slow and partial separation of the components, giving fractions whose boiling ranges overlap and vary continuously over the whole range represented by the original mixture. Moreover, the tar acids decompose during fractionation, particularly the higher boiling fractions, so that final results are of quesionable significance. The principal changes in composition which take place in the tar acids are apparently due to oxidation, and it was therefore thought better to fractionate the tar acids along with the balance of the tar oils, which, because they contain other easily oxidized substances, might serve to protect

The experimental data of this paper were used by H. A. Beekhuis in a thesis presented in candidacy for the Ph.D. degree at Yale University in June, 1926.

the tar acids against oxidation. For this purpose the total tar distillate was distilled and cuts taken at 10 to 15 degrees intervals up to 270 deg. C. Above this temperature the decomposition of the oil was such as to render results of no value. Each fraction was then separated into three fractions, the middle one boiling over the range of the initial fraction, the other two being combined with other distillates as in the usual procedure of orderly fractionation. After eight distillations, the tar acids were separated from the tar oils in the usual way and each tar acid fraction once distilled. The results of this procedure are given in Table I.

Table I—Fractionation of Tar Oils

Boiling Ranges of Final Tar Oil Fractions Deg. C.	Boiling Ranges of Corresponding Tar Acid Fractions Deg. C.	Specific Gravity of Tar Acids at 25 Deg./4 Deg.
To 186	185–195	1.0485
186–195	192–200	1.0387
195–205	200–207	1.0230
205–215	206–216	1.0174
215–230	214–223	1.0070
230–240	224–238	1.0045
240–250	236–250	1.0109
250–260	246–260	1.0217

These results are indicative of the complexity of the tar-oil mixture and of the very slow separation of the components by fractional distillation. It is of interest that the specific gravities of the tar acid fractions plotted against their average boiling points give a curve which passes through a minimum at the 224-238 deg. C. fraction. Since the specific gravities of monohydroxyphenols decrease steadily from phenol onward, it is probable that there are dihydroxy phenols present in the higher boiling fractions. In fact, the fraction boiling 236-250 deg. C. was shown to have considerabde quinol or its homologues present.

Fractional Distillation of the Tar Acid Ethers

In the fractionation of tar oils or of tar acids there is always more or less oxidation of the phenols, as mentioned above. Since the aromatic-aliphatic ethers are much more stable bodies then the corresponding phenols, it was thought worth while to try fractionation of the methyl ethers of the tar acid mixture. For this purpose two samples of the tar acids were taken; one sample was converted to the methyl ethers by the usual methyl iodide method, and the other sample was converted to the methyl ethers by the dimethyl sulphate method. The two methyl ether products were then subjected to orderly fractional distillation carried, as before, through eight cycles. The average equivalent weights of the various fractions were then determined by the Zeisel method. The results are given in Table II and shown graphically in Fig. 2.

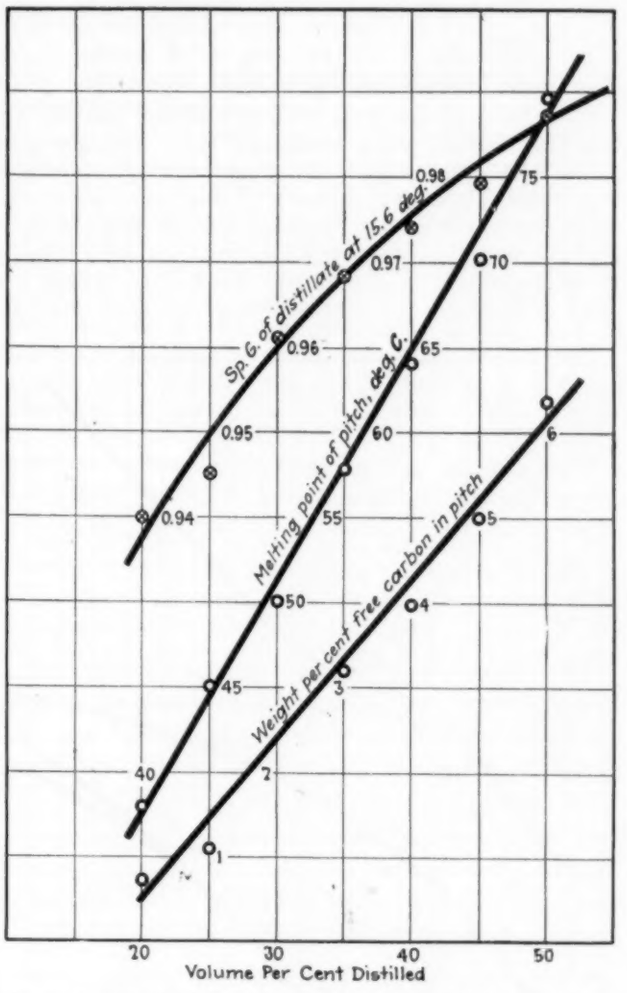

Fig. 1—Specific Gravity of Distillate, Melting Point of Pitch and Per Cent Weight of Free Carbon in Pitch from Low Temperature Tar

It will be noted that the specific gravity curve of the tar acid ethers passes through a minimum, as noted previously for the tar acids, and that the equivalent weight curve shows a corresponding break. Morgan and Meighan (*Ind. Eng. Chem.*, 17, 626, 696, 854) determined the equivalent weights of the various tar acid fractions from a low-temperature tar which was very similar to the one used in the present investigation, and drew a smooth curve through the various points determined experimentally. An examination of their data, in view of that presented in Fig. 2, makes it appear that they should logically have shown a break in the equivalent weight curve in the boiling range

Table II—Distillation Characteristics of Tar Acid Ethers

Methyl Iodide Method				Dimethyl Sulphate Method				
Cut	Average Dist. Temp.	Weight Per Cent Distilled	Sp. G. at 25 deg. C.	Cut	Average Dist. Temp.	Weight per cent distilled	Sp. G. at 25 deg. C.	Equiv. Weight
161–173	166	2.4	.969	–173	166	2.6	.....	118
173–183	178	11.5	.964	173–184	178.5	11.8	.964	129
183–193	188	21.3	.960	184–194	189	23.5	.959	141
193–203	198	36.2	.955	194–205	199	38.1	.955	160
203–213	208	46.4	.953	205–214	209	49.1	.953	167
213–223	218	53.7	.956	214.224	219	55.8	.957	166
223–233	228	59.2	.968	224–234	229	61.2	.971	171
233–248	240.5	69.9	.982	234.250	242	71.0	.986	181
248–263	255.5	74.4	.998	250–265	257.5	78.5	.999	193
263–277	270	84.3	1.015	265–281	273	85.2	1.020	210
277–293	285	89.7	1.032	281–296	288.5	91.0	1.039	229
293–308	300.5	94.8	1.043	296–310	303	94.3	1.049	250
308–332	320	99.0	1.051	310–337	323.5	100	1.063	256
332–337	334.5	100						

where the specific gravity curve of the tar acids passes a minimum.

Condensation Products of Tar Acids

The tar acid fractions boiling 190-230, 230-265 and 265-315 degrees were condensed with formaldehyde, using both the alkaline and acid methods, and the resulting Bakelite products examined. The lower boiling tar acids condensed readily, the high boiling ones less readily, and in all cases the Bakelite products were inferior to those which were obtained when pure phenol was used. Some of the acid-resisting varnishes obtained

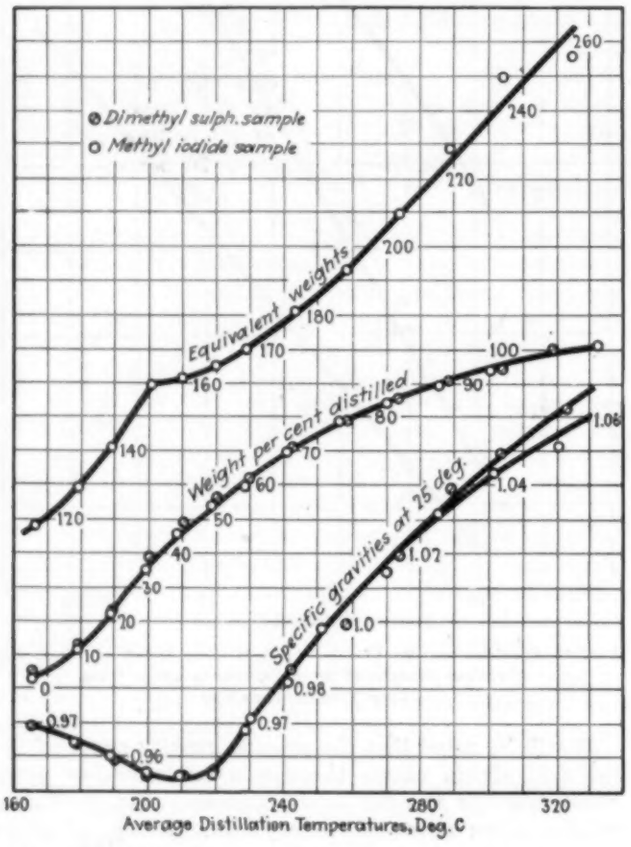

Fig. 2—Specific Gravities, Distillation Curves and Equivalent Weights for Methyl Ethers of Low Temperature Tar Acids

were, however, of such quality as to suggest a possible commercial use of certain tar acid fractions for this purpose.

The tar acids are also condensed by sulphur chloride with liberation of hydrogen chloride. If the sulphur chloride were added directly to the tar acids, the reaction was rapid at first, but became slow as the mixture grew viscous, and the final product was a spongy mass. By dissolving the tar acids in benzol before adding the sulphur chloride there was obtained at first a benzol-soluble condensation product. Using one part of the 190-230 degree fraction of tar acids, two parts of benzol and one part of sulphur chloride there was obtained a product which may be used directly as a varnish, the benzol evaporating to leave a smooth acid-resisting film. Further additions of sulphur chloride, or heating the initial product at 150 deg. C. gave a product resembling Bakelite in resistance to solvents and acids but black in color and not as strong as Bakelite. The ease with which these sulphur chloride condensation products can be formed and their acid-resisting qualities invite further examination of them than was attempted in the present investigation.

Fractional Distillation of the Neutral Oils

The so-called tar acids in tar oil may be removed by repeated washing of the oil with caustic soda solution and the small amount of bases then washed out with sulphuric acid. The residual oil is usually referred to as the neutral oil. Like the tar acid fraction, this neutral oil is a complex mixture from which individual compounds cannot be separated by ordinary fractional distillation. In the present investigation 2,710 grams of neutral oil were first distilled into twenty-three fractions and orderly fractionation then applied through eight cycles, all the oil distilling above 365 deg. C. being collected as one fraction. The weights and specific gravities of the final fractions are given in Table III and represented graphically in Fig. 3. The fractionation curve is again indicative of a complex mixture of compounds whose boiling points collectively cover a wide temperature range. The specific gravity curve is a little irregular, the irregularities being, we believe, not due to experimental errors.

Morgan and Soule reported that the lower boiling fractions of neutral oil darken rapidly on standing. This darkening appears to be caused by incomplete removal of sulphuric acid before fractionation, since we found that if great care be used in removing the acid before fractionation, the lower boiling fractions retain their light yellow color for several months while the fractions boiling above 220 deg. C. darken slowly.

Table III—Distillation Characteristics of Neutral Oil

Cut	Average Dist. Temp.	Weight Per Cent Distilled	Specific Gravity at 25 Deg./4 Deg.
To 149	127+	3.2	0.807
149 –168.5	159.7	6.9	.829
168.5–183	175.7	10.4	.841
183 –198.5	190.7	14.3	.851
198.5–210	204.2	18.4	.868
210 –223	216.5	23.6	.880
223 –231	227	27.4	.892
231 –238.5	234.7	31.3	.906
238.5–246.5	242.5	36.3	1915
246.5–254	250.2	40.7	.921
254 –259	256.5	44.1	.930
259 –267.5	263.2	50.3	.937
267.5–276	271.7	55.8	.942
276 –285	280.5	61.8	.944
285 –293	289	66.2	.948
293 –304.5	298.7	71.7	.956
304.5–315	309.7	77.4	.965
315 –324	319.5	80.9	....
324 –335	329.5	85.3	.975
335 –340.5	337.7	87.3	....
340.5–350	345.2	89.6	....
350 –365	357.5	91.7	....

The Sulphur Compounds in Neutral Oil

There are sulphur compounds in the neutral oils and these appear to be distributed all along the line when the oil is fractionally distilled. For example, in the present investigation the sulphur content of the neutral oil fractions boiling 183-198, 246.5-254, and 293-304.5 degrees was determined by the oxygen bomb method, the amounts of sulphur found being respectively 0.44, 0.57 and 0.53 per cent. These sulphur compounds are not readily removed by the ordinary desulphurization agents used in petroleum refining.

Halogenation and Oxidation of the Neutral Oil

The neutral oil was highly unsaturated, more than 80 per cent of it being soluble in concentrated sulphuric acid. The difference in behavior toward halogens and permanganate was, however, remarkable. When a little bromine or chlorine was first added, the halogen

was absorbed without liberation of halogen acid. As more halogen was added, the acid was liberated and the oil darkened; with further additions the oil again became clear and finally absorbed about 50 per cent of its weight of chlorine.

When dilute neutral permanganate solution was added to the oil, the former was at once decolorized, as noted by Morgan and Soule. If, however, the addition of dilute neutral permanganate were continued an end point was reached long before any considerable portion of the oil had been oxidized. Using 88 grams of oil of specific gravity 0.880, a permanent pink was obtained when dilute neutral permanganate containing 40 grams of potassium permanganate had been added. There were recovered 80 grams of oil (some being lost in the operation) whose specific gravity was 0.875 and whose boiling range was the same as the original. The aqueous solution from the reaction vessel was evaporated to dryness and acidified. Considerable effervescence indicated that potassium carbonate was present. The acid solution was then extracted with ether and the ether evaporated. There remained 3 grams of a liquid smelling strongly of acetic acid.

The oil recovered from this oxidation procedure was next treated with dilute permanganate solution in 0.5 normal alkali. Reaction was rapid only at first and after several days' treatment the 80 grams of oil had decolorized the solution containing only 20 grams of potassium permanganate. Only a few per cent of the oil had been oxidized, its specific gravity being finally 0.872. It is remarkable that the neutral oil should show such resistance to dilute permanganate oxidation in view of its apparent unsaturation.

Liquid Phase Cracking of Neutral Oils

During the course of this investigation a small pressure still of one liter capacity was constructed and a considerable number of cracking tests carried out with various fractions of the neutral oil, using pressures from 100 to 500 lb. The data obtained permit the following conclusions to be drawn.

1. Cracking below 400 deg. C. is very slow, while above 450 deg. C. coke formation becomes rapid with accompanying high gas yield.

2. The effect of pressure upon the rapidity and character of the cracking is but slight in the range used.

3. The effect of cracking any neutral oil fraction is to widen the boiling range of the combined distillate and residuum. The same relative difference in the boiling range between fractions of the neutral oil is maintained even after extensive cracking. This differs from results usually obtained in petroleum cracking, and in the case of the neutral oil makes the kerosene fraction the only part suitable for the production of a motor fuel, since the spread in boiling range is not great if the few per cent of the extreme ends of the boiling range be neglected. By cracking the kerosene fraction of neutral oil the total yield of oil boiling below 210 deg. C. can be increased from the 20 per cent of the neutral oil initially present to about 35 per cent. The stability of the cyclic compounds present is thought to be the cause of the behavior found on cracking. The few per cent of extreme light ends (boiling under 150 deg. C.) found in each case seem to have their origin in the small amount of paraffin and naphthene hydrocarbons originally present, as specific gravity measurement and concentrated sulphuric acid treatment showed these fractions, contrary to all others, to be largely saturated and with specific gravities near the corresponding paraffin and naphthene hydrocarbons.

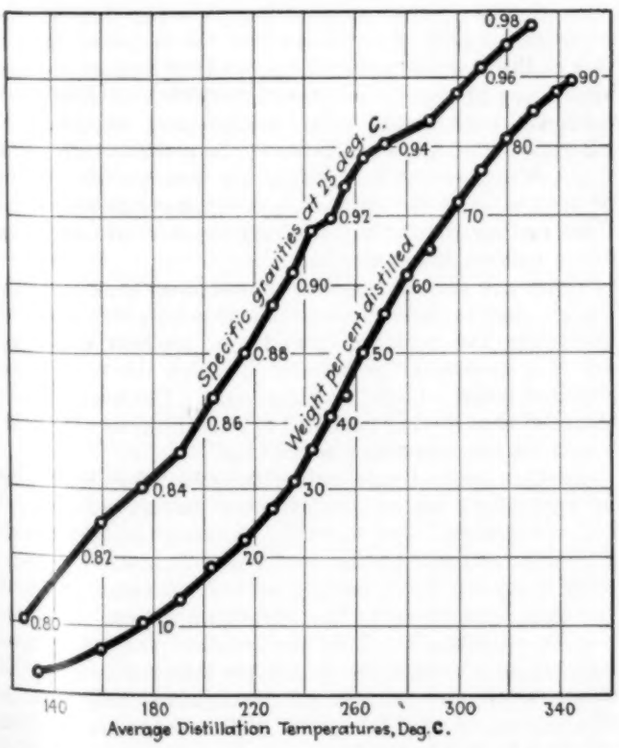

Fig. 3—Distillation Curve and Specific Gravities of Neutral Oil from Low Temperature Tar

Value of Continuous Furnaces For Porcelain Enameling

In a recent issue of the *Enamelist*, R. A. Weaver summarized the views of a number of technical men in the porcelain enameling industry on the advantages or disadvantages of using continuous furnaces.

The general consensus of opinion was that the amount of annealing that would be secured in any of the continuous enameling furnaces that have been built so far would not be sufficient to be of any value. Theoretically, it was pretty generally agreed that if the heating up process and the cooling down process could be prolonged over a period of three or four hours, one might get an annealing effect that would be of value.

Ross Purdy pointed out that glass used as enamel on steel was different from blown or pressed glass, in that it had no strains set up in it from the method of manufacture. He stated that the qualities of enamel depend on the general quality of the glass and that annealing would be of little help.

Dr. R. R. Shively stated that the porcelain is so thin, relative to the thickness of the steel, that the slower cooling of the steel serves to anneal it fairly well.

H. G. Wolfram called attention to the differing coefficients of expansion of glass and steel, which work to prevent effective annealing.

R. R. Danielson and H. F. Staley were inclined to believe that annealing would be helpful, but that there would be a danger if the time of annealing were extended, as a loss of gloss might be caused by subjecting the enamel parts to the high temperature.

R. D. Landrum stated that he had made experiments to see whether or not slow cooling would add to the durability of the ware, and the results of these experiments did not show any change that was measurable.

Reducing Evaporation Loss in the Petroleum Industry

Last year new equipment and improved practice saved millions of dollars worth of petroleum products

By Ludwig Schmidt
Associate Petroleum Engineer, U. S. Bureau of Mines, Bartlesville, Oklahoma

EVAPORATION of crude petroleum and of refined petroleum products is perhaps one of the most important sources of loss in industry. Certainly it is one of the most insidious. Oil has a relatively large coefficient of expansion, and a change of volume of several per cent may take place because of the normal range of yearly temperatures. This physical condition, together with the difficulties inherent in measuring and gaging large volumes of liquid, often tend to hide the fact that loss by evaporation is taking place. Only when the "shrinkage" is computed over a long period of time, for the petroleum industry as a whole, is its magnitude apparent.

Formerly Nine Per Cent of Crude Oil Lost

From Well to Refinery.—In 1920 and 1921, Wiggins (Bureau of Mines Bulletin 200) made an extensive study of the evaporation losses of crude oil in the Mid-Continent field. The investigation covered the various stages of handling crude oil from the well to the refinery. The results of the investigation are as follows:

Location of loss	Average Percentage Evaporated
Flow tank	1.0
Filling lease tank	1.0
Lease storage	1.5
Gathering systems	1.0
Transportation	1.0
Tank farms	0.7
Total	6.2

Refinery Losses—During the early spring and summer of 1923 the writer conducted a series of tests in several refineries in the Mid-Continent territory and estimated the average evaporation losses of gasoline, in its various stages of handling to be as follows:

Location of loss	Average Percentage Evaporated
Run down tanks	1.0
Treating	0.5
Filling tank car	0.5
Storage	2.5
Miscellaneous handling	1.0
Total	6.3

The total evaporation loss of 6.3 per cent of the gasoline corresponds to a loss of 2.1 per cent of the crude run to the plant based on the assumption that the gasoline yield is one-third of the volume of the crude oil.

Losses in Use.—No detailed tests on the evaporation of petroleum products in the hands of dealers and of users have been made, but the total loss can be estimated from the refinery tests and would amount to about 3 per cent.

The sum of the figures indicates that 9 per cent of the crude oil that comes from our wells is lost by evaporation.

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During the past three years many improvements have been made in equipment and in methods of operation in the oil industry. Losses from evaporation of crude oil and gasoline are probably only one-half as great at the present as they were in 1922 and 1923. The average evaporation loss on the lease as shown in the tabulation was 3.5 per cent. If a similar study were made today this loss would probably be about one per cent.

Pipeline companies are constantly installing new and improved equipment, but it is doubtful if they have reduced the sum of the gathering system and main line transportation loss below 2 per cent. This is due to the fact that the most volatile constituents which formerly were allowed to evaporate on the lease are now conserved in the oil and delivered to the pipeline which results in the pipeline handling a more volatile product.

The average loss from large storage tanks has been reduced at least 50 per cent. Although the oil delivered to storage is more volatile, improved tankage more than offsets this increase in volatility. Tests made on new equipment show an average decrease of 50 per cent of the evaporation losses of gasoline in the refinery.

How Evaporation Losses are Reduced

Space does not permit the discussion in detail of the various methods now used in reducing evaporation losses of crude oil and gasoline. However, the following general conclusions may be of help to those interested in this problem:

Evaporation may be defined as the slow forming of vapor on the surface of a liquid. Some of the main factors which influence the rate of evaporation of a given liquid are:

(1) Temperature of the surface of the liquid. (2) Quantity of vapor in the surrounding atmosphere. (3) Area of evaporation surface. (4) Renewal of air, over evaporating surface. In order to control the rate of evaporation one or more of the above factors must be controlled and in actual practice a combination of two or more of these factors is used.

In the past, the greatest losses were due to the unrestricted flow of fresh air over the evaporating surface of the storage tanks. This has been largely reduced by the use of vapor-tight tanks properly equipped with vapor-tight gage and thief hatches and vacuum-and-pressure relief valves. However, in a vapor-tight tank there is a constant renewal of air over the liquid due to breathing of the tank caused by atmospheric variations and by displacement of air-vapor mixtures when filling and emptying the tank.

There are several methods of reducing the breathing losses; one is by collecting all vapors given off and extracting the gasoline from them; another is by the use of a gasometer or balloon in which the vapors are collected when a tank "breathes out." The system is so balanced that during periods of "breathing in" the tank draws on the gasometer or balloon.

Another method is to reduce the amount of breathing by controlling the action of those factors which promote breathing. For example, painting the tanks with light-colored paint, water sprays and insulation prevent wide temperature variations within the vapor space of the tank thus reducing the breathing action. In addition to reducing the wide temperature variation these methods also reduce the maximum temperatures of the vapor space and surface of the liquid. This reduces the amount of gasoline vapor in the vapor-air mixture expelled from the tank.

Holding a pressure on storage tanks has been successful in reducing the evaporation losses from natural-gas gasoline. Lease storage tanks have been operated for some time under pressures from a few ounces to as high as 5 lb. In the past, the use of pressure tanks has been limited. However, recent tests by Britton and Brinton of the Standard Oil Co. of New Jersey (see *National Petroleum News*, July 21, 1926, p. 24) show that 80,000-bbl. gasoline storage tanks equipped with pressure valves operating at 13 in. of water pressure lost by evaporation 0.21 per cent per year as compared with losses of about 2 per cent on all-steel vapor-tight gasoline storage tanks of the same size and painted light colors.

Floating roofs reduce evaporation losses by reducing to a minimum the evaporating surface and practically eliminating vapor space above the liquid surface. This type of tank construction is especially useful for working tanks, as it prevents the larger volume of air being drawn into the vapor space when the tank is emptied and the consequent expulsion of this air when the tank is filled.

Actual tests show that it is possible to save at least 50 per cent of the ordinary evaporation loss by means of vapor-tight tanks properly equipped and between 80 and 90 per cent with the more expensive and elaborate systems. Irrespective of the system adopted, the results obtained will depend to a large extent upon the care given the equipment and upon careful operation. Inexpensive systems properly cared for may give better results than more expensive equipment which is allowed to shift for itself.

In conclusion, the importance of the use of evaporation reducing equipment and methods is best shown in dollars and cents. In 1925, the total product of crude oil in Oklahoma and Kansas was about 201,421,655 bbl. Prior to the use of evaporation-reducing methods the evaporation losses would have been 6.5 per cent from the well to the refinery and 2.1 per cent in the refinery or a total of 8.6 per cent. This amounts to about 17,322,264 bbl. per year. However, by the use of improved methods the evaporation loss was reduced about 50 per cent or 8,661,132 bbl. Assuming the value of the oil saved to be $1.50 per bbl., then the total saving would be about $12,991,698. This figure is based upon volumetric loss only and does not take into consideration the increased value of the crude oil due to change in gravity. The actual saving from a conservation viewpoint is much greater than indicated because those fractions lost through evaporation are the most volatile constituents of the crude—the gasoline fraction. Assuming the value of the gasoline to be 10c. per gal. or $4.20 per bbl., then the total saving for 1925 would be about $36,376,754.

Rubber Breather Bags

One of the first effective means of checking evaporation losses from gasoline in storage was the rubber breather bags or balloons developed by the Standard Oil Co. of Indiana during 1924 and 1925. A special gasoline-proof fabric is used and from it have been constructed large balloons which are housed in galvanized iron buildings and connected to the vapor space of the storage tank. When the gasoline-saturated air at the top of the tank expands it merely goes into the breather bag while the temperature is rising and is sucked back again when the tank cools off at night, thus preventing any loss.

Corrosion Resistance of Metals and Alloys

Dr. W. M. Guertler outlines magnitude of problem and suggests means of approach

THE MAGNITUDE of the corrosion problem and the justification for its intensive study by the chemical engineer has recently been forcibly emphasized by Dr. William M. Guertler, director of the Metal Institute of the Technische Hochschule, Berlin, who is visiting this country as the guest of the American Society for Steel Treating. Before a joint meeting of the New York sections of this society and the American Institute of Mining and Metallurgical Engineers on October 27, 1926, Dr. Guertler presented a chart showing two large cubes. The larger one represented in volume the world's production of metal in thirty years previous to 1924—amounting in all to 1,766 million tons. The other cube represented the metal lost by corrosion in the same period, amounting to 718 million tons.

Dr. Guertler showed that from a study of thermochemical data we must expect all metals to corrode in the ordinary sense of the expression, except perhaps the noble metals, and also showed that the tendency towards corrosion, which might be referred to as corrosion affinity, as well as the corrosion rates of all metals at specific temperatures, were direct functions of specific molecular heat evolution incident to union with the corroding agent in question.

However, this rate is subject to retardation by the formation of protective coatings in such instances where the products of the corrosive action are not removed incident to their formation by solution or otherwise.

Dr. Guertler pointed out the relation of these phenomena to the passivity of some metals and to the good corrosion resistance of some eight commercial metals when protective coatings are formed and not subject to ready removal. For example, he showed that aluminum resists nitric acid effectively because the Al_2O_3 formed is insoluble in the acid and adherent to the face of the metal; likewise, lead resists dilute sulphuric acid and iron resists concentrated sulphuric acid. The five other commercial metals were copper, tin, zinc, nickel and magnesium.

Dr. Guertler summarized his lecture by stressing the following points which the chemical engineer must consider when trying to develop new corrosion resisting alloys:

1. As a base, use iron, nickel or copper, because these are cheap or relatively cheap metals and because they form solid solutions with the principal corrosion resisting metals.
2. Consider only alloys forming true solid solutions. Metal compounds cause brittleness and other alloys are corroded, due to localized galvanic action.
3. Solid solutions give the alloy the corrosion resisting property of the resistant component; as example, chromium-iron alloys compare with chromium.
4. The chemical properties of the alloys depend upon the solubility of the salts formed; that is, upon protective coating formation.
5. Always avoid possibility of galvanic action.
6. Never hope to find an everlastingly good or universally applicable alloy, for no one alloy will ever resist all corroding agents equally well.

Chemical Engineering in the Rubber Industry

Many opportunities afforded for the chemical engineer in this rapidly growing field

By Raymond B. Stringfield
Chief Chemist, Goodyear Tire & Rubber Co. of Calif.
Los Angeles, Calif.

WHEN Dr. Guiseppi Bruni of the University of Milan was in Akron, the center of the American rubber industry, two years ago, he compared the technical side of the industry to a semi-permeable membrane; a great deal gets in from the outside but very little gets out from the inside.

In spite of much valuable work which has been published, especially by rubber chemists, this comparison has been all too true. It is difficult for those outside of an industry to absorb its details. To the general public, and even to many of the old time rubber men, the mechanical side of the industry has been so obvious as to overshadow its chemical engineering aspects, and in many cases to delay progress.

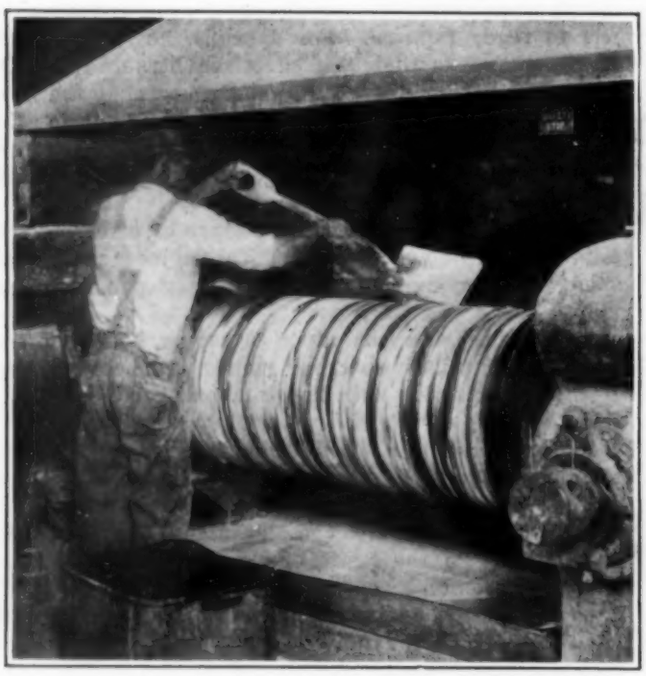
Chemical Engineering Viewpoint

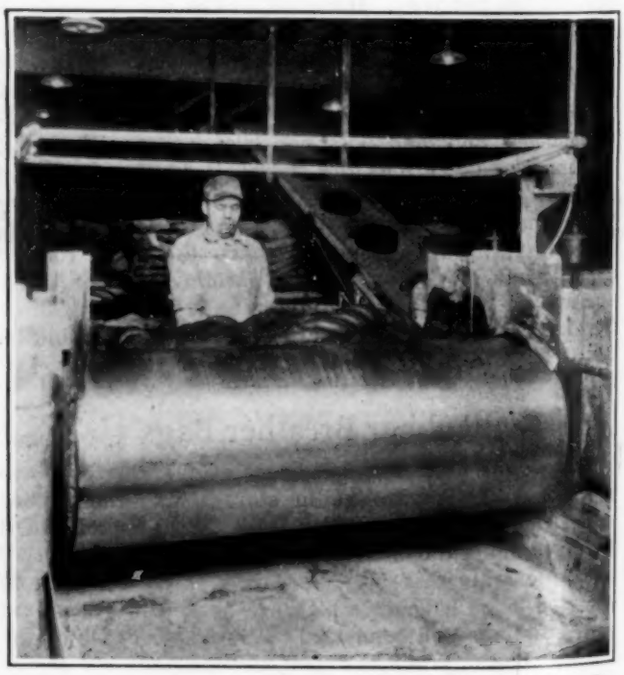
In the present discussion it is not desired in any way to belittle the enormously valuable work of the mechanical engineer, which has been so largely responsible for the economical production of rubber goods in large quantities, but rather to call attention to the many places in the industry where the chemical engineer's training is essential and where he is contributing largely to efficiency and progress. The points of view are quite different. The mechanical engineer sees the ordinary rubber mixing mill as two rolls going around, which require large amounts of power and involve various transmission and lubrication difficulties. The chemical engineer sees the same mill as a machine which is malaxating a plastic colloid, the final condition of which is determined by the time, temperature, speed and gage of milling. The mechanical engineer sees a roll of freshly coated rubberized fabric as something which has been calendered to gage and which will later be cut up into strips of the proper width and length, while his chemical engineering brother knows that upon the plasticity of the stock, the temperature and rate of cooling, and the conditions under which the roll is aged, depend the workability of these strips and the freedom from trouble in subsequent operations.

Need Begins with Raw Rubber

Rubber, as it comes to the market, is one of the most variable of raw materials, and as yet only the most progressive companies have recognized that the work of the chemical engineer should start on the plantation. Rubber latex is an easily coagulable colloid, and the properties of the coagulated rubber depend on the fermentation, if any, which takes place before coagulation, the pH value at the time of coagulation, and the subsequent history of the product during preliminary processing. Unfortunately, so much of the world's production comes from uncontrolled plantations, that the best the average factory can do is to test the rubber carefully as it is received and then to blend it as much as possible in order to equalize variations in quality, stiffness and rate of cure.

The weighing and mixing of the raw batch, and its subsequent shaping by tubing or calendering, involve a series of chemical engineering problems little suspected by the casual observer. The batch may contain ingredients varying in specific gravity from rubber, 0.93, to zinc oxide, 5.57, or litharge, 9.28. It must be uniformly mixed, keeping in mind the requirements of curing as well as the physical properties of the ingredients. In many operations the volume of stock used is estimated





Photographs supplied by Goodyear Tire & Rubber Co.

Figs. 1 and 2—The Contrasting Viewpoints of the Chemical and Mechanical Engineers as to What Happens During the Milling of Rubber
The mechanical engineer sees the 84-in. rubber mixing mill as two huge rolls that require large amounts of power and involve various transmission and lubrication difficulties. The chemical engineer sees the same mill as a machine that is malaxating a plastic colloid, the final condition of which is determined by the time, temperature, speed and gage of milling.

by weight and any variation in gravity results in either too little stock or excessive overflows. These ingredients must be incorporated with as little wastage as possible. Many plants find that 5 per cent of the carbon black purchased is lost before finally reaching the finished product.

Mixing involves heat transfer on a large scale, the heat generated by internal friction being often 680 B.t.u. per pound of stock, or enough to raise the temperature to over 1,900 deg. F. if the heat is not removed. Moreover, this heat must be carried away rapidly and uniformly, to prevent premature vulcanization or "scorching," and to obtain uniform plasticity in the finished product. The lower the temperature, the softer the stock for the same amount of milling; accordingly the control of mill-water temperature by recirculation, spray ponds and even refrigeration becomes a matter of dollars and cents to be compared with possible savings in labor, power and overhead.

Needed Improvements in Calendering

Calendering and tubing involve the sheeting and extrusion of the hot plastic unvulcanized stock to a predetermined gage or shape, and bring with them all the accompanying variables of a colloid affected by its previous history, temperature, plasticity, rate of extrusion, etc. Much progress remains to be made in the control of calender temperatures, improvement of heat transfer in tube machines, more scientific design of tube machine dies, development of automatic feeding to improve stock uniformity, and uniform cooling of the product to improve handling conditions.

Vulcanization in its ordinary form, is a heat reaction, the rate of which is a logarithmic function of the temperature. Heat transfer and the uniformity of heating are factors of vital importance. In many thick bodies,

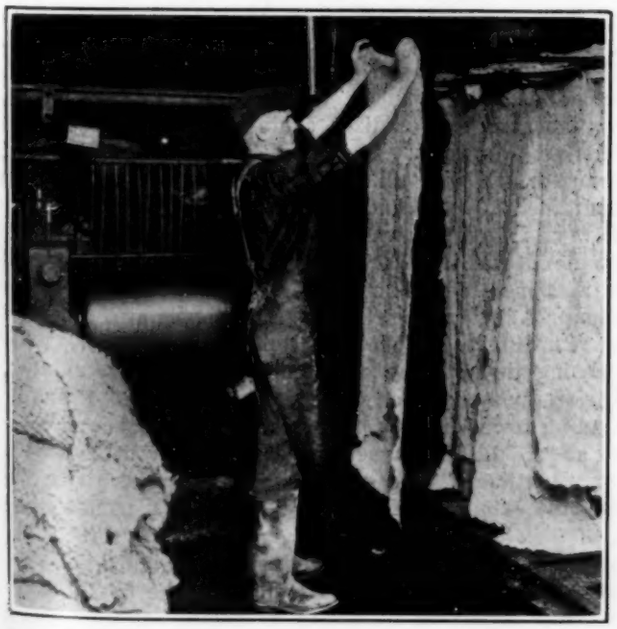


Fig. 3—Sheeting Rubber: The Final Step in the Milling Process

as for instance automobile tires, the rate of cure of the stocks used must be adjusted to correspond to their location in the article. The outside of the article may receive a cure of several hours, while the heat penetrating to the inside may be equivalent to only a few minutes. In the case of cures in open steam, such as inner tubes, the manner of admitting the steam must be carefully considered, in order to prevent a portion of the charge becoming vulcanized faster than the whole.

Vulcanization by sulphur chloride, the so-called vapor cure, involves the ordinary chemical engineering problems of concentration and circulation of the vapor, and of selecting proper materials of construction to resist corrosion, as does also the gas or Peachey cure, using sulphur dioxide and hydrogen sulphide.

Many other items could be mentioned in which chemical engineering is involved. The manufacture of rubber cements involves the solvation and dispersion of the colloid, the previous history of which affects the char-

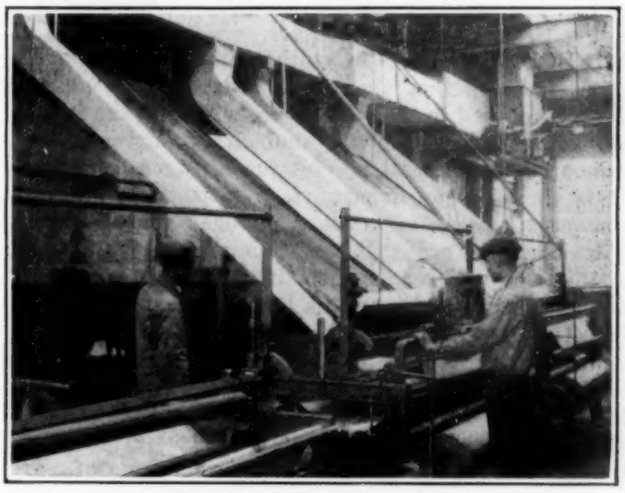


Fig. 4—Applying a Final Coat of Rubber Cement in a Coated Fabric Plant

acter of the cement, as does also the type of solvent, the temperature of mixing, the exposure to light and air, and many other factories. The manufacture of accelerators and anti-oxidants is obviously a chemical engineering industry, and brings in such previously unused compounds as ethylidine aniline, diorthotolylguanidine, and mercaptobenzothiazole.

Chemical Engineering Saves Millions

One other branch of the rubber industry, however, deserves special mention, namely that of reclaiming. The reclaiming of scrap rubber has for years been one of the carefully guarded rule-of-thumb industries, presided over by the "practical rubber man," and it is only recently that the chemical engineer has gained an entrance. He found much to interest him, and also much to amuse. The carefully guarded devulcanizers had much in common with the digestors used for paper pulp. Washing, dewatering and drying equipment could be duplicated in the sugar, mining and many other industries. No better example of unit processes could be found. In fact, take away the selection of the raw batch and the testing and compounding of the finished product, and the average chemical engineer would feel perfectly at home.

The result of the chemical engineer's entrance into this industry has been that the latest refinements in equipment have been introduced, costs have been lowered, recoveries increased, the product made better and more uniform and, finally, a saving of millions of dollars to the public made possible by the intelligent and legitimate substitution of high-quality reclaim for part of the rubber in many products.

Separating Nitrogen Oxides from Ammonia Oxidation Gas

Solid adsorbents, particularly pulverized silica gel, offer attractive possibilities for production of concentrated nitrogen oxides

By Norman W. Krase

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RECENT advances in synthetic ammonia technology indicate that the great bulk of fixed nitrogen produced in the near future will be in the form of ammonia. The market for ammonia is, however, small compared to the total market for nitrogen compounds. It is therefore of importance to explore methods for converting ammonia to other nitrogen compounds and particularly to accomplish such improvements in these methods as will render them more applicable commercially. To one phase of this large problem the present investigation is directed, namely the conversion of ammonia to nitric acid. It is not proposed to review the literature relating to ammonia oxidation or to the many improvements that have been proposed. Consideration will be limited to the problems arising from the use of solid adsorbents for the separation of nitrogen oxides from ammonia oxidation gas.

This application of solid adsorbents for the removal and concentration of nitrogen oxides from diluting gas offers many attractive possibilities. The elimination of water-absorption methods, which at best can yield only dilute nitric acid, is the chief gain. On the other hand the production of concentrated nitrogen oxides—in liquid form if desired—would furnish chemical industry with a new and potentially useful raw material. Liquid nitrogen tetroxide can readily be shipped in steel containers with even less hazard than attends the shipping of chlorine. The conversion of concentrated nitrogen oxides to nitric acid of any desired strength is considered a feasible commercial operation.

While several substances [German Patents 212,423 and 243, 892; *Chem. Ztg.*, p. 581 (1910)] have been suggested as suitable for the removal of nitrogen oxides from other gases, by adsorption, the present investigation is concerned only with the use of silica gel. An outstanding property of this substance is its high affinity or specificity for water vapor. Since water vapor is formed concurrently with nitric oxide in the oxidation of ammonia, it becomes necessary to provide means for removing this water, or at least reducing its concentration to a small value, before the adsorptive capacity of the silica gel for nitrogen oxides can be effectively employed.

Most of the previous work involving the use of silica gel has been performed with granules packed in towers which are kept cool during the passage of the gas to be treated and then heated to drive off the adsorbed vapors in concentrated form. In some cases a static method has been employed in which the vapor and gel remain in contact until equilibrium has been established. These two methods yield essentially the same results, as should be expected.

Quite a different method of applying silica gel has been reported by one concern [Bulletin No. 2, Silica Gel Corporation, Baltimore, Md. (1921)] and also by Holden [*Chem. & Met. Eng.*, vol. 28, p. 804 (1923)]. This involves the use of pulverized silica gel which is introduced into the gas stream and carried along in suspension as a dust cloud during the period in which adsorption occurs and is then removed and heated to recover the adsorbed vapors. Because of its extreme fineness, the gel is saturated almost instantly.

The present work has been concerned only with the use of pulverized gel and deals with:

1. Determination of the carrying power of gas streams for pulverized silica gel.
2. Methods of cooling nitrose gas to accomplish removal of the greater part of the water without excessive condensation of nitric acid.
3. Study of the adsorption of nitrogen oxides from nitrose gas by silica gel suspended in the gas stream.

Experimental Apparatus

In order to duplicate actual conditions with regard to the temperature and composition of nitrose gas, a small ammonia oxidizer was used. Fig. 1 shows the apparatus. The oxidizer contained a platinum gauze catalyst 3 in. square heated by the current from a 1-kw. transformer. In all cases the ammonia-air mixture contained 10 per cent of ammonia by volume and the flow of mixed gas was kept at 35 liters per min. The ammonia was taken from a cylinder, metered and mixed with a metered stream of air supplied by a rotary air pump. After mixing, the gas stream was again metered with a differential pressure capillary flow meter. After passing through the electrically-heated gauze catalyst, the gas passed directly to the cooling tower. From the cooling tower the gas passed into an oxidation chamber of about 50 liters capacity; provision was made for the introduction of a measured amount of excess air to control the extent of oxidation of NO to NO_2. The nitrose gas then entered the lower end of the adsorber tube into which was fed pulverized, activated silica gel. The suspension of gel and gas passed up the tube and the gel was separated by means of baffles suitably located at the upper end. The treated gel was collected in tubes closed at the lower end and was thereby readily removed for analysis. In order to equalize the static pressure of the flowing gas at the discharge end of the screw conveyor which fed gel into the adsorber tube, a connection was made as shown in Fig. 1 by means of a "diffusion bottle." This arrangement insured a steady feed of gel independent of the rate of gas flow.

Abstracted from dissertation presented to Graduate Faculty, Yale University, in Candidacy for degree of Doctor of Philosophy.

Table I.—Relation Between Air Flow and Carrying Power of Air Stream

Tube Diameter = 1.58 in.
Tube Height = 9 ft.
Gel Size = 50 to 80-mesh.

Exp. No.	Air Flow, Liters per Min.	Air Velocity, Meters per Min.	Gm. Gel Carried up Tube, per Min.	Gm. Gel Carried up Tube, per Liter
1	50	39.55	6.25	0.125
2	60	47.50	19.03	0.317
3	70	55.30	43.33	0.619
4	80	63.30	71.5	0.894
5	90	71.20	98.5	1.09

Gel Size = 100 to 150-mesh.

Exp. No.	Air Flow, Liters per Min.	Air Velocity Meters per Min.	Gm. Gel Carried up Tube, per Min.	Gm. Gel Carried up Tube, per Liter
1	50	39.55	7.7	0.154
2	60	47.50	22.0	0.367
3	70	55.30	50.66	0.724
4	80	63.30	80.	1.00
5	90	71.20	109.	1.21

Gel Size = 170 to 200-mesh

Exp. No.	Air Flow, Liters per Min.	Air Velocity, Meters per Min.	Gm. Gel Carried up Tube per Min.	Gm. Gel Carried up Tube per Liter
1	30	23.75	1.95	0.065
2	35	27.65	3.25	0.093
3	40	31.65	4.55	0.114
4	45	35.60	7.5	0.167
5	50	39.55	9.5	0.19
6	60	47.50	28.4	0.47
7	65	51.40	43.5	0.68
8	70	55.30	65.3	0.93
9	80	63.30	99.5	1.24
10	90	71.20	135.7	1.51

Silica Gel Suspensions in Air

To obtain data on the carrying power of gas streams for powdered silica gel, experiments were made in which the velocity of the gas, the size of adsorber tube, and the size of gel were varied successively. Air was used in these experiments, and the flow was varied between 15 and 90 liters per min. The tubes used were 1.03 and 1.58 in. in diameter and the gel sizes were:

A. Through 50, retained on 80-mesh sieve.
B. Through 100, retained on 150-mesh sieve.
C. Through 170, retained on 200-mesh sieve.

Tables I and II contain the data which in all cases are averages of the results of several experiments.

The data in Tables I and II are shown graphically in Figs. 2, 3, 4 and 5. The tube diameters given on these graphs have been rounded off for simplicity. Fig. 2 shows the relation between the rate of air flow

Table II—Relation Between Air Flow and Carrying Power of Air Stream

Tube Diameter = 1.03 in.
Tube Height = 9 ft.
Gel Size = 170 to 200-Mesh

Exp. No.	Air Flow, Liters per Min.	Air Velocity, Meters per Min.	Gm. Gel Carried up Tube per Min.	Gm. Gel Carried up Tube per Liter
1	15.0	27.83	1.33	0.089
2	17.5	32.45	2.17	0.124
3	20.0	37.10	3.67	0.184
4	22.5	41.75	5.75	0.256
5	25.9	48.00	15.66	0.605
6	30.0	55.65	33.61	1.120
7	35.0	65.00	55.00	1.571
8	37.5	69.60	64.13	1.710
9	40.0	74.20	76.63	1.916

in liters per minute and the carrying power of the air stream as expressed in grams of gel delivered at the top of the 9-ft. tube per minute. It is seen that below certain rates of flow, the carrying power increases quite slowly with increased rate of flow but that the relation becomes linear as the flow is increased. Considering only the region in which the linear relation holds true, it is evident that the rate of increase of carrying power, as shown by the slope of the lines, is greatest for the finest gel and decreases as the size of gel increases. Also, since the slope of the straight lines for 170- to 200-mesh gel in the two tubes is approximately the same, the rate of increase of the carrying power of the air stream is dependent on the gel size rather than on the diameter of the tubes.

Fig. 3 shows the relation between the rate of air flow in liters per minute and the concentration of gel attained at the top to the 9-ft. tube when the concentration is expressed in grams of gel per liter of air. Considering the same range of air flow that gave a linear relation in Fig. 2, it is seen that the curves are concave upward and that this curvature increases as the size of gel increases. The concentration of gel, therefore, increases less rapidly with the rate of air flow in the case of large gel than it does with smaller gel particles.

Fig. 4 shows the relation between the air velocity in meters per minute and the amount of gel carried up the tube in grams per minute. This plot permits the direct comparison of the carrying power of the air stream in different size tubes. Curves *A* and *D* show that with the same size gel the carrying power increases much more rapidly in the larger tube than in the smaller. This may be ascribed to the "wall effect"

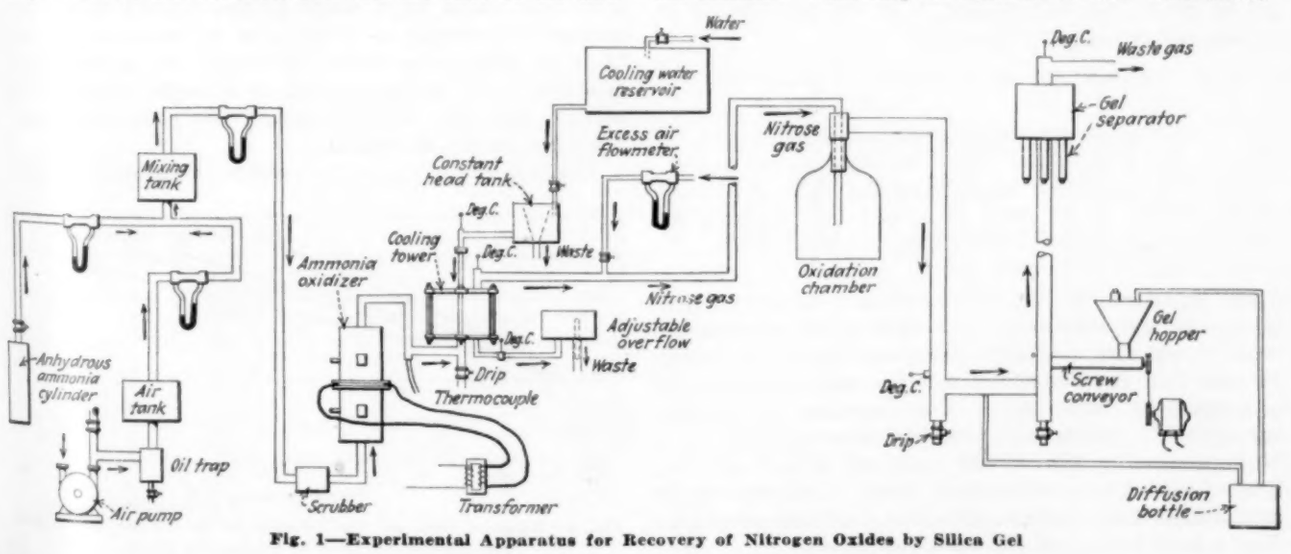

Fig. 1—Experimental Apparatus for Recovery of Nitrogen Oxides by Silica Gel

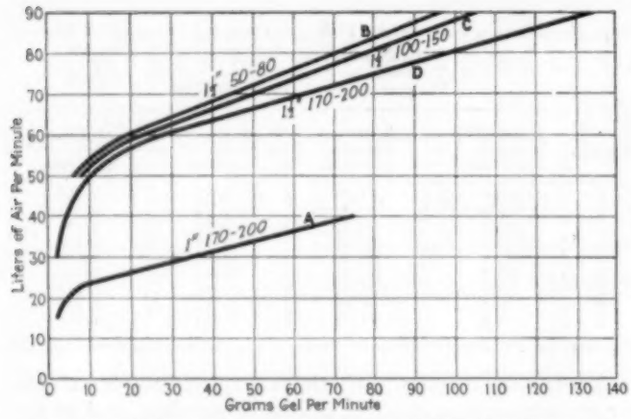

Fig. 2—Relation Between Air Flow and Carrying Power of Air Stream

Rate of air flow is expressed in liters per minute and carrying power of air stream is expressed in grams of gel delivered at top of 9-ft. tube per minute.

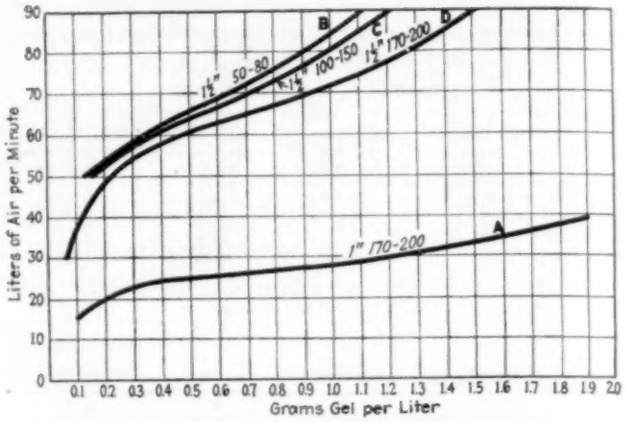

Fig. 3—Relation Between Air Flow in Liters per Minute and Gel Concentration

Rate of air flow is expressed in liters per minute and gel concentration is expressed in grams of gel per liter of air at top of 9-ft. tube.

since in the smaller tube a given particle is on the average much longer in contact with the wall of the tube than is the case in the larger tube. The effect of the wall in knocking down suspensions of powder obviously becomes much more pronounced as the diameter of the tube is decreased. Curves *B*, *C*, and *D* show that the rate of increase of carrying power becomes greater as the size of gel is decreased.

Fig. 5 permits a direct comparison between the "saturation concentrations," of gel suspensions as a function of air velocity in different size tubes. At any given velocity the concentration of the cloud is greater in the 1-in. tube than in the 1½-in. tube, as shown by curves *A* and *D*.

Referring again to Fig. 4, and considering the range of air velocity where the curves are straight lines, it is possible to write the equations of the straight lines in terms of the variables plotted. If V is the air velocity in meters per minute and M is the amount of gel carried up the tube in grams per minute, the equations are:

$$\text{Curve } A: \quad V = 0.435\,M + 40.8$$
$$\text{Curve } B: \quad V = 0.303\,M + 42.7$$
$$\text{Curve } C: \quad V = 0.37\,M + 42.2$$
$$\text{Curve } D: \quad V = 0.218\,M + 41.5$$

From these equations there may be derived others which fit the curves in Fig. 5 above velocities of about 45 meters per min. When C is the concentration of gel in grams per minute and V is the air velocity in meters per minute, the equations are:

$$\text{Curve } A: \quad C = 4.27 - \frac{174.3}{V}$$
$$\text{Curve } B: \quad C = 2.61 - \frac{111.3}{V}$$
$$\text{Curve } C: \quad C = 2.93 - \frac{123.5}{V}$$
$$\text{Curve } D: \quad C = 3.63 - \frac{150.5}{V}$$

These equations permit the calculation of the concentration of gel obtainable as a cloud with a given air velocity, gel size, and tube diameter. It is interesting to note that each equation sets an upper limit to the concentration obtainable. For example, at infinite velocity the maximum concentration obtainable in a 1-in. tube using 170- to 200-mesh gel is 4.27 gm. per liter of air. This calculation is based, of course, on the assumption that the straight line relations shown in Fig. 4 hold far above the velocities shown.

The data just discussed are sufficient to indicate the feasibility of suspending sufficient powdered gel in the gas stream to accomplish the removal of NO_x. Starting with an air-ammonia mixture containing 10 per cent of ammonia by volume and assuming an oxidation efficiency of 95 per cent and a loss of 1 per cent of the NO_x on cooling the nitrose gas to room temperature, the concentration of NO_x entering the adsorber tube will vary between 6 and 8 per cent depending on the amount of excess air added to the gas after cooling. At this concentration active gel will adsorb approximately 5 per cent of its weight of NO_x. To remove completely the NO_x it would require from two to three treatments of gas by gel, assuming that the gel concentration is 1.5 gm. per liter. Greater concentrations of gel than this are easily maintained as shown by the preceding curves.

Cooling Ammonia Oxidation Gas

Any method for the recovery of nitrogen oxides from ammonia oxidation gas involving the use of adsorbents presupposes cooling the hot gases without appreciable losses of fixed nitrogen as nitric acid. This cooling operation is necessary not only for the purpose of facilitating adsorption but also to accomplish the removal of a large part of the water formed in oxidizing ammonia. The application of a cooling method whereby the hot gases are brought into actual contact with cold water must result in the formation of only negligible amounts of nitric acid to warrant its use. It is of great importance, therefore, in investigating adsorbents for the separation of nitrogen oxides from nitrose gas, that efficient means for removing water from the gas be developed.

The type of cooling tower used in the present investi-

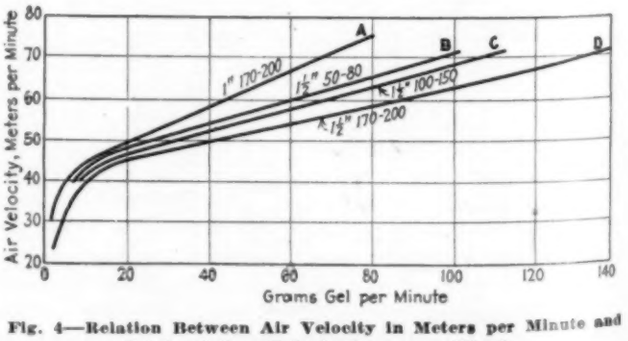

Fig. 4—Relation Between Air Velocity in Meters per Minute and Gel Carried up Tube in Grams per Minute

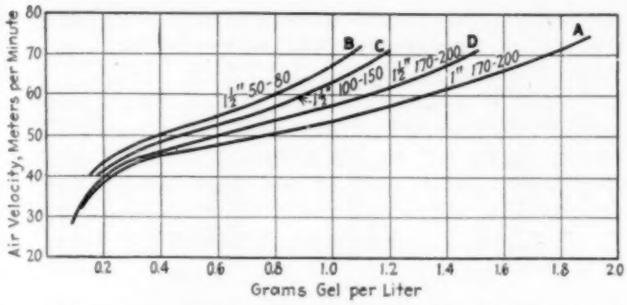

Fig. 5—Direct Comparison Between "Saturation Concentrations" of Gel Suspensions as Function of Air Velocity in Various Size Tubes

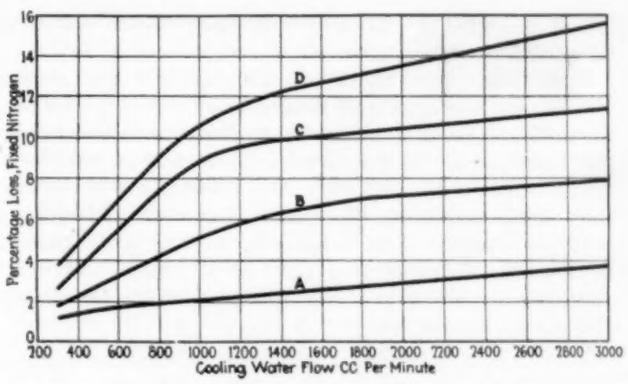

Fig. 7—Losses of Fixed Nitrogen on Cooling as Function of Rate of Flow of Cooling Water

gation is shown in detail in Fig. 6. The nitrose gas passed from the oxidizer through a short length of ¾-in. aluminum pipe into the lower end of the cooling tower. The tower used in preliminary experiments was 18 in. high and 6 in. in diameter. It was filled with aluminum helices made from No. 17 gage wire; these helices were about ⅝ in. long and about ⅜ in. in diameter. Tower packing of this kind has been described by Manning [*Chem. & Met. Eng.*, vol. 29, p. 504 (1923)]. The helices were made by winding the wire in the form of a long spring on a ⅜-in. rod held between the centers of a lathe. The spring was then removed from the rod, stretched until about twice its original length and cut into short sections. The two ends of the wire were turned in toward the center of the helix to prevent their catching on other helices when packed in a tower. Cooling water entered the top of the packed tower and flowed down, wetting the surface exposed by the packing. The hot gas passed up the tower in contact with the cooling water. The first tower used in these experiments proved to be entirely satisfactory for reducing the temperature of the gas, but the amount of nitric acid formed during cooling and carried out with the water was excessive. The preliminary results indicated that sufficient cooling could be effected with a much smaller tower. Decreasing the tower volume would, of course, result in a shorter time of contact of gas and cooling water; this would mean a much smaller loss of nitrogen as nitric acid.

In order to establish some relation between the size

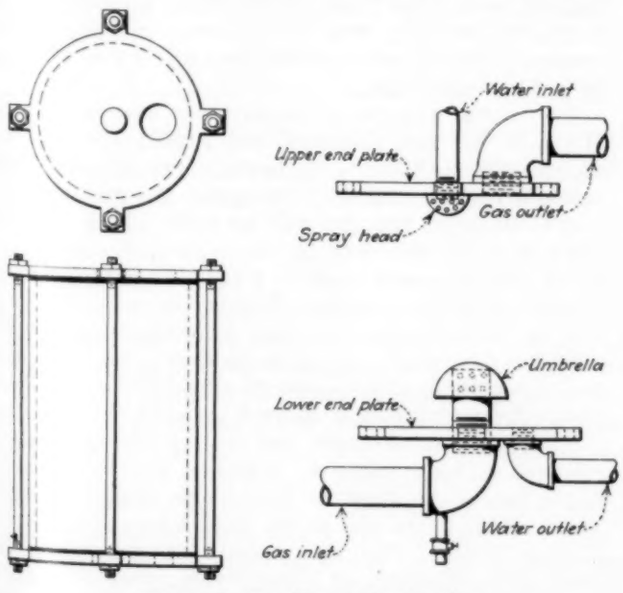

Fig. 6—Cooling Tower Construction

of cooling tower and the extent of formation of nitric acid during cooling, a number of towers all of the same diameter but of varying heights were used successively. These towers were cut from aluminum tubing 3¾ in. inside diameter and 4 in. outside diameter. The ends were squared off in a lathe and closed with aluminum plates also turned to fit the ends of the tubes. Asbestos gaskets were placed in the joints and the three pieces held firmly together by four ½-in. threaded rods. The lower plate was connected permanently to the ¾-in. pipe leading from the oxidizer and also carried the ½-in. pipe through which the cooling water left the tower. These connections were made by drilling and tapping the ¼-in. plate and screwing in the pipe connections as shown. The gas inlet pipe extended up into the tower 1½ in. and was capped by an umbrella-shaped cup to prevent water from entering the pipe. The gas passed out through holes bored in the pipe and was deflected downward and out by the umbrella. A short length of ¼-in. pipe was screwed into the elbow at the lower end of the tower as shown for the purpose of draining out condensate which formed when the apparatus was started. Once hot, no condensate formed in this line. The pipe through which cooling water left the tower was flush with the inside face of the lower end plate. This pipe led to an adjustable overflow tank by which the varying pressure in the tower under different operating conditions could be balanced by a water head. A thermometer in this pipe gave the exit temperature of the cooling water. The temperature of the gas entering the tower was obtained by means of a copper-constantan thermocouple placed in the pipe as shown and read by means of a Leeds and Northrup pontentiometer. This arrangement is clearly shown in Fig. 1, p. 675.

The upper end plate of the tower carried the cooling water supply pipe and spray head which was centrally placed so as to insure uniform wetting of the packing. The spray head was made from a ½-in. round pipe cap in which numerous holes were drilled to direct water radially to all parts of the tower. A uniform flow of cooling water was obtained by placing an orifice in the pipe leading from the constant head tank to the tower. This orifice could readiliy be changed to obtain any desired flow of cooling water. A 110-gal. tank served to store cooling water at room temperature. A thermometer was placed in the water line as shown. The gas outlet pipe also was permanently screwed into the upper end plate flush with the inside face. A thermometer in this line gave the exit temperature of the nitrose gas. A tee in this line placed close to the

tower provided a connection through which air could be added to the nitrose gas.

Since the results obtained with cooling towers depend entirely on the type and design of the tower used in a particular case, it is necessary to describe in some detail the "constants" of the towers used in this work. All four towers were cut from the same piece of tubing; they had, therefore, the same diameter and differed only in length. The same size and type of packing previously described was used in all cases. Table III contains a summary of the essential characteristics of the four towers.

Table III—Characteristics of Cooling Towers

Tower No.	Height, Cm.	Weight Helices, Gm.	Free Space, Cc.	Total Surface, Sq.Cm.
1	6.98	111	377	1,646
2	10.50	166	609	2,465
3	12.53	200	742	2,966
4	15.57	247	942	3,667

In preparing and packing the towers the weight of packing taken was made proportional to the height of the tower; this gave approximately a fixed ratio between the other characteristics indicated in the table.

Nitric Acid Losses on Cooling

The method of determining the losses of fixed nitrogen on cooling the hot gas coming from the oxidizer was as follows: The cooling water was started flowing through the tower, the current switched on to heat the gauze catalyst, the ammonia and air streams adjusted to the proper values and the apparatus allowed to operate until steady conditions were established. This was indicated by the constancy of the several thermometer readings and occurred usually about 20 min. after starting the gas flow. Readings were taken of the inlet and outlet temperatures of the gas and of the cooling water. Samples of cooling water were collected for analysis and titrated immediately. Duplicate readings and analyses were obtained for all conditions of operation. In this way the four cooling towers were used successively. The rate of flow of cooling water was varied from about 200 c.c. per min. to more than 3,000 c.c. per min. The temperature of the cooling water for all experiments was approximately 18.5 deg. C. The temperature of the inlet gas was 240 deg. C. in all cases. The results are given in Table IV.

Table IV—Nitric Acid Losses on Cooling

Cooling Water Flow, C.c. per Minute	Temperature, Deg. C.		Per Cent Loss Fixed Nitrogen
	Outlet Water	Outlet Gas	
	Tower No. 1		
200	37.0	36.5	0.93
455	29.4	29.3	1.50
735	26.5	27.0	1.98
920	25.4	26.5	1.92
1,670	23.2	24.9	2.63
2,000	23.0	24.1	2.85
3,080	22.0	23.6	3.70
	Tower No. 2		
375	32.0	32.5	2.53
590	28.0	29.0	3.27
700	27.5	27.5	3.77
785	27.0	27.0	3.83
880	26.5	25.7	4.52
1,270	25.0	25.1	6.47
2,500	23.0	23.5	7.50
3,170	22.5	23.3	8.09
	Tower No. 3		
205	38.0	39.0	1.81
410	31.0	30.8	3.50
665	28.0	26.0	6.03
770	27.0	24.9	7.05
800	27.0	25.2	7.68
905	26.5	24.0	8.50
1,600	24.1	23.2	10.20
3,400	22.6	23.0	11.70
	Tower No. 4		
210	39.8	35.5	3.05
320	34.0	32.8	3.52
750	27.5	25.8	8.61
990	26.0	24.5	10.67
1,565	24.3	23.6	12.67
3,060	23.0	23.5	15 80

The data are shown graphically in Fig. 7 where the losses of fixed nitrogen on cooling as a function of the rate of flow of cooling water are plotted. Curves *A*, *B*, *C* and *D* are for towers Nos. 1, 2, 3 and 4 respectively. It is seen that the losses on cooling increase with the size of the tower and with the flow of cooling water. The four curves indicate that the losses are approximately in proportion to the size of cooling tower used.

It is of considerable significance that satisfactory cooling of the hot nitrose gas can be accomplished with small losses of nitrogen as nitric acid. Tower No. 1 with a total volume of approximately 500 c.c. effectively cools a gas stream of 35,000 c.c. per min. It is safe to assume that this ratio of gas flow to tower volume, 70 to 1, is the lower limit necessary for cooling by this method. It is possible, therefore, to reduce the gas temperature from about 250 deg. C. to room temperature practically instantaneously and with low losses of nitric acid. It is through this temperature range that rapid cooling is most necessary since the rate of formation of nitric acid is enormously accelerated as the temperature is lowered.

The function of the cooling tower is to reduce the temperature of the gas to about 25 deg. C. and the water content to about 3 per cent by volume. The gas leaving the tower will contain approximately 10 per cent nitrogen dioxide equivalent by volume, that is if nitric oxide and nitrogen tetroxide are calculated to the basis of dioxide. Further reaction between the nitrogen dioxide and water will, of course, occur and condensation of nitric acid will take place. Some data [Almquist, Gaddy and Braham: *J. Ind. & Eng. Chem.*, vol. 17, p. 599 (1925)] exists to indicate that the condensate is about 60 per cent nitric acid. The amount of nitric acid formed will depend on the time interval elapsing between cooling and adsorption. To avoid the formation of excessive amounts of nitric acid, this time interval should be made as short as possible. It is inevitable, however, that any process involving partial removal of water will produce some nitric acid of about 60 per cent strength.

The partial pressure of water vapor over 60 per cent HNO_3 is 7.3 mm. [Burdick and Freed: *J.A.C.S.*, vol. 43, p. 518 (1921)]. If equilibrium is established between the gas and the condensate, the percentage of water vapor in the gas will be 0.96. This means a removal of 68 per cent of the original 3 per cent of water and a removal of about 6 per cent of the nitrogen dioxide originally present. Whether or not equilibrium will be established is uncertain and will depend on the conditions existing. It has been shown, however, that the upper limit of nitrogen dioxide loss by this "secondary" condensation is about 6 per cent.

The gas coming from the cooling tower must be allowed sufficient time to complete the oxidation of nitric oxide. In order to hasten the oxidation, excess air is added to the gas at the point where it leaves the cooling tower. For the purpose of calculating the degree of oxidation of nitric oxide reached under a given set of conditions it is convenient to use the data

and curves prepared by the Nitrogen Products Committee, Munitions Inventions Department [Physical and Chemical Data of Nitrogen Compounds: *M.I.D. Research Lab.* (1918)]. Starting with a flow of 35 liters per min. of 10 per cent ammonia-air mixture, having an oxidation efficiency at the gauze catalyst of 95 per cent, and a loss of 1 per cent of fixed nitrogen on cooling, the gas issuing from the cooling tower will have the following composition:

NO	=	3.29 liters per minute
O_2	=	2.24 liters per minute
N_2	=	24.89 liters per minute
H_2O	=	0.98 liters per minute
Total	=	31.4 liters per minute

In the present case the volume provided between the cooling tower and adsorber was 50 liters. The time during which reaction of nitric oxide and oxygen could occur if no air were added is, therefore $\frac{50 \times 60}{31.4} = 95.5$ sec. Since the gas is fairly dilute with respect to the reacting substances, we may consider the reaction to take place at constant volume. In this case it is immaterial whether the reaction is

$$2\,NO + O_2 \rightleftarrows 2\,NO_2, \quad \text{or}$$
$$2\,NO + O_2 \rightleftarrows N_2O_4.$$

When no excess air is used, calculation shows that 83.5 per cent of the nitric oxide is oxidized in 95.5 sec. Similar calculations made on the basis of different amounts of added air give the following results:

Excess Air, Liters per Minute	Time, Seconds	Per Cent Oxidation in 50 Liters Space	Final Concentration NO_2 in per Cent by Volume
0	95.5	83.5	8.74
5	82.4	88.0	7.95
10	72.4	90.0	7.15

On the assumption that equilibrium between the gas and condensed nitric acid is established during the time the gas is passing from the cooling tower to the adsorber, the composition of the gas entering the adsorber will be that given in the following table:

Excess Air, Liters per Minute	Total Gas Flow, Liters per Minute	Per Cent NO_2 by Volume	Per Cent H_2O by Volume
0	31.4	8.22	0.96
5	36.4	7.47	0.86
10	41.4	6.72	0.76

Adsorption of Nitrogen Oxides

The apparatus used for performing adsorption experiments is shown in Fig. 1. It was essentially similar to the apparatus used in studying gel suspensions in air with the exception that the gel suspension was formed in a ¾-in. iron pipe 10.5 ft. long. The gas coming from the cooling tower passed through a trap to separate the condensate and then into the adsorber. The method of introducing gel into the gas stream was exactly as previously described. The separation of gel from the gas stream at the upper end of the adsorber was accomplished by means of baffle plates which discharged the gel into four tubes at the lower end of the separator. Gel was taken from these tubes by removing the stoppers at the lower end of the tubes.

Adsorption data were collected by the use of two sizes of gel powder, 100 to 150 mesh, and 170 to 200 mesh. The gel was prepared for use by heating in an electric muffle furnace at 300 deg. C. for approximately 18 hr. and cooling in a desiccator. An adsorption experiment consisted in operating the ammonia oxidation apparatus and cooling tower to obtain the usual composition of nitrose gas, feeding active gel into the gas stream for a known time interval, collecting, weighing and analyzing the gel deposited in the separator at the top of the adsorber. The NO_2 content of the gel was determined by direct titration of the gel with NaOH and H_2SO_4 using methyl red as an indicator. Blank analyses on the original active gel samples were made. The experimental results are given in the following table:

	Gel Size, Mesh	Excess Air, Liters per Min.		
		0	5	10
Grams NO_2 per 100 grams gel.	100 to 150	4.6	3.8	2.9
	170 to 200	4.8	3.8	3.0
Gel carried by in grams per minute	100 to 150	50.3	69.2	87.0
	170 to 200	56.5	76.5	95.5
Grams NO_2 adsorbed per minute	100 to 150	2.31	2.63	2.52
	170 to 200	2.71	2.91	2.86
Per cent of total NO_2 removed by gel	100 to 150	37.3	42.4	40.6
	170 to 200	43.7	47.0	46.1

The temperature of the nitrose gas entering the lower end of the adsorber varied somewhat with the room temperature but was approximately 31 deg. C. for all experiments. The temperature of the gas leaving the gel separator when no gel was being added to the gas stream was about 33 deg. C. showing a rise of 2 deg. C. due to the oxidation of nitric oxide in the adsorber. The gas outlet temperature during the addition of gel to the gas stream (the adsorption temperature) was always close to 35 deg. C. It was expected that this temperature would depend on the extent of adsorption but since both samples of gel under all conditions showed only small variations in adsorptive capacity no significant temperature variations were observed.

The table shows that somewhat less than half of the nitrogen dioxide present in the gas was removed by adsorption; the amount removed varied between 37 and 47 per cent of the total. Repeated treatment of the gas by gel would be necessary to recover all of the NO_2. This could be accomplished by a series of adsorbers, identical with the one described, through which the nitrose gas would pass successively while fresh gel would be added to the gas stream in each adsorber. An alternate arrangement, and one more suited to the utilization of the minimum amount of gel, would be to take the gel coming from the last of a series of adsorbers and adding it to the gas stream in the second from the last adsorber, then adding it to the gas in the third from the last adsorber and so on. This arrangement would utilize the maximum adsorptive capacity of the gel since all of it would be exposed to the richest gas in the first adsorber. This method utilizes the familiar counter-current principle although during actual adsorption the flow of gel is with the current of gas.

The author is indebted to the Fixed Nitrogen Research Laboratory, U. S. Department of Agriculture, for financial aid and other assistance in carrying out this investigation. In particular, grateful acknowledgment is made to Prof. Harry A. Curtis, under whose general supervision this work was completed.

Theory of the Absorption Tower

Derivation of Equations for Investigating Fundamentals of Gas-Scrubbing

By R. C. Cantelo

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IN THE present article is derived a series of equations which may be used for investigating the fundamental design of gas-scrubbing towers, as applied to continuous counter-current absorption. Towers with intermittent flushing will be considered in a later article.

The assumptions made are (1) that the velocities of carrier and extractor are uniform, (2) that the carrier is air. The second assumption is made solely for convenience, and the argument given here will apply for any carrier.

Since the process is continuous, a definite weight of air, W lb., passes out from the tower every hour. Therefore, this quantity W lb. of air per hour passes across every section of the tower. W may be expressed in terms of U, the measured volume of air, in cu.ft. per hour issuing from the tower.

$U.d' = W$, where d' is the density of the air in lb. per cu.ft. under the conditions prevailing at the top of the tower. So that

$$U \cdot \frac{29}{360} \cdot \frac{273}{T'} \cdot \frac{B}{760} (1 - p_w' - p') = W \qquad (1)$$

where T' = temperature in degrees Kelvin at top of tower.

B = barometric reading in mm.

p'_w = vapor pressure of extractor at T'.

p' = partial pressure of the solute in the carrier at the top of the tower. p' is a constant quantity for a steady state.

Again, let u = velocity of the carrier in linear ft. per hr. at any point x in the tower, and let d be the density in lb. per cu.ft. of the carrier (air) under conditions prevailing in the tower. Let A = cross-section of the tower and r = the fraction of free volume per cu.ft. of gross volume. Then $u \cdot d \cdot rA = W$ (2)

$$\text{or} \quad \frac{dx}{dt} = \frac{W}{rA} \cdot v$$

where v = specific volume in cu.ft. per lb. of the carrier.

So that

$$\frac{dx}{dt} = \frac{W}{rA} \cdot \frac{360}{29} \cdot \frac{T}{273} \cdot \frac{760}{B(1 - p_w - p)} \qquad (3)$$

where T is the average temperature prevailing in the tower, and may be taken equal to $\frac{T_o + T'}{2}$, T_o being the temperature where the carrier enters the tower.

p_w = vapor pressure of water at T and

p = partial pressure of the solute at the point x.

Frequently, it will be necessary to express p in terms of m, the lb. per cu.ft. of solute gas in the carrier (plus solute). This may be done as follows,

$$p = \frac{16m}{M} \times 0.0821 \times T = \frac{1.314T}{M} \cdot m \qquad (4)$$

where M = molecular weight of solute.

Substituting equations (1) and (4), equation (3) becomes

$$\frac{dx}{dt} = \frac{MU}{1.314rAT'} \cdot \frac{(1 - p'_w - p')}{\left[\frac{M}{1.314T}(1 - p_w) - m\right]} \qquad (5)$$

Let $\frac{MU}{1.314rAT'} = B$; and $\left[\frac{M}{1.314T}(1 - p_w)\right] = a$.

Then equation (5) may be written

$$\frac{dx}{dt} = \frac{B(1 - p'_w - p')}{(a - m)} \qquad (6)$$

Case I—The solute obeys Henry's Law.

The equation for the rate of solution of solute is[1]

$$\frac{dm}{dt} = -k_2(km - n) \qquad (7)$$

where k_2 = dissolution coefficient, which under strictly specified conditions is a constant.

n = lb. per cu.ft. of solute in the extractor at the point x. The relation

$$V_c \cdot dm = V_e \cdot dn \qquad (8)$$

enables n to be expressed in terms of m.

V_c = velocity of the carrier in cu.ft. per hr.

V_e = velocity of the extractor in cu.ft. per hr.

Upon integration

$$n = \frac{V_c}{V_e} m + C$$

$n = fm + C$, where $f = \frac{V_c}{V_e}$ = flow ratio

when $n = N'$ = lb. per cu.ft. in entering extractor

$m = M'$ = lb. per cu.ft. in issuing carrier

$\therefore n = fm + C$

$N' = fM' + C$ and subtracting and rearranging.

$n = fm - fM' + N'$.

Equation (7) becomes, therefore

$$\frac{dm}{dt} = -k_2 \left\{(k - f)m + (fM' - N')\right\} \qquad (9)$$

Dividing equation (9) by equation (6)

$$\frac{dm}{dx} = \frac{-k_2 \left\{(k - f)m + (fM' - N')\right\}(a - m)}{B(1 - p'_w - p')}$$

$$\text{or} \quad \frac{dm}{\left\{(k - f)m + (fM' - N')\right\}(a - m)} = \frac{-k_2 dx}{B(1 - p'_w - p')}$$

which gives upon integration

$$\frac{1}{a(k - f) + (fM' - N')} \cdot \ln \frac{a - m}{(k - f)m + (fM' - N')} = \frac{k_2 x}{B(1 - p'_w - p')} + C.$$

$$\text{or} \quad \frac{1}{a(k - f) + (fM' - N')} \cdot \ln \frac{a - m}{(k - f)m + (fM' - N')}\Bigg]_{M_o}^{M} = \frac{k_2 x}{B(1 - p'_w - p')}\Bigg]_0^h$$

$$\frac{1}{a(k - f) + (fM' - N')} \cdot \ln \frac{(a - M')(k - f)M_o + (fM' - N')}{(kM' - N')(a - M_o)} = \frac{k_2 h}{B(1 - p'_w - p')} \qquad (10)$$

k_2 the dissolution coefficient is now a function of the physical properties of the extractor and of the coefficient of packing, i.e., of the area of interface between carrier and extractor, in sq.ft. per cu.ft. of packing. Also, it is known to be a function of the flow ratio f and of the surface films at the interface of the carrier and extractor. The dependence of k_2 for a given tower upon any of these variables is now determinable by actual experiment.

Case I (a). The solute obeys Henry's Law and $N' = O$.

Equation (10) becomes

$$\frac{1}{a(k-f)+fM'} \cdot \ln \frac{(a-M')\,[(k-f)M_o+fM']}{(kM')\,(a-M_o)} = \frac{k_g h}{B(1-p'_w-p')}. \quad (11)$$

Case II. The solute obeys Raoult's Law. This is the problem involved in the absorption of benzene from coal gas[3] and of gasoline from natural gas[3] by a mineral oil.

Here $p = p_s x$

where p_s = vapor pressure of the pure solute under the conditions given, and x = its mole fraction in the liquid phase.

Case II differs from Case I only in the necessity of evaluating k, the Henry coefficient.

$$k = \frac{n}{m} = \frac{\text{concentration in liquid phase}}{\text{concentration in gas phase}}.$$

Let v_1 be the specific volume of the solvent and therefore of the dilute solution, and let M_1 = molecular weight of solvent. Then in one liter of solution there are $\frac{1{,}000}{M_1 v_1}$ moles of solvent and $\frac{1{,}000x}{M_1 v_1}$ moles of solute, approximately.[4]

Then if C be the concentration of the solute in moles per liter in the liquid phase,

$$C = \frac{1{,}000x}{M_1 v_1}$$ and if c = concentration in moles per liter in the gaseous phase

$$c = \frac{p}{RT} = \frac{p_s x}{RT}$$

$$\therefore \frac{C}{c} = \frac{1{,}000RT}{M_1 v_1 p_s} = k, \quad (12)$$

so that $k = \frac{82.1T}{M_1 v_1 p_s}$ where p_s is expressed in atmospheres.

Equations (10) or (11) now apply to Case II.

Case III. A chemical reaction takes place between the solute and extractor and the compound formed exerts an inappreciable vapor pressure.

The equation for the rate of reaction of the solute with the extractor is

$$\frac{dp}{dt} = -k_g p \quad (13)$$

where p is the partial pressure of the solute in the carrier.

Equations (1) and (3) combined give

$$\frac{dx}{dt} = \frac{UT}{rAT'} \frac{(1-p'_w-p')}{(1-p_w-p)} \quad (14)$$

Dividing (13) by (14)

$$\frac{dp}{dx} = -\frac{k_g rAT'}{UT} \frac{p(1-p_w-p)}{(1-p'_w-p')}$$

Writing $\frac{rAT'}{UT(1-p'_w-p')} = B'$ and $a' = (1-p_w)$

$$\frac{dp}{p(a'-p)} = -k_g B' dx$$

$$\frac{1}{a'} \ln \frac{a'-p}{p} \Big]_{p_o}^{p'} = k_g B' x \Big]_0^{h_o}$$

$$\frac{1}{a'} \ln \frac{p_o(a'-p')}{p'(a'-p_o)} = k_g B' h \quad (15)$$

The modification necessary when the compound exerts a vapor pressure is obvious.

Case IV. The solute is very soluble in the extractor. The rate of solution is determined by the partial pressure of the solute in the carrier[5], i.e., it obeys the equation

$$\frac{dp}{dt} = -k_g p.$$

Accordingly, equation (15) applies also to Class IV.

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Rosin for Making Rosin Oil

Low grades of gum produce richest oils, but these should be free from foreign matter

By Brian S. Brown

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TO the manufacturer of rosin oils the most important specification for rosin can be expressed in one word—cleanliness. Peculiarly, the low grades, *B* and *D*, produce the richest oils, and these are the very grades the producers are prone to be most careless in straining. The facts that these are the cheapest grades, that the inspector can degrade *B* and *D* but one grade, and that the darkness of color of these rosins makes it difficult for the inspector to see dirt, makes the producer careless of cleanliness to a point that the rosin oil manufacturers suffer.

Rosin oil is made by the destructive distillation of rosin in cast-iron stills, a residue of black pitch in amount of approximately 3 per cent remaining in the still. After each charge this is drawn off, but regularly after a periodical number of runs, it is necessary to close down the stills, let them cool, and then with chisels clean out the conglomerate of dirt and pitch, similar to concrete in its properties. The number of charges which can be run before closing down is inversely proportional to the amount of foreign matter in the rosin. To one familiar with the loss of efficiency from such a shutting down no more need be said.

Characteristics of Good Rosin

As stated already, the richest oils are produced from the darker grades of rosin, but the rosin must not be burned in the process of manufacture. This produces a rosin which will make a rosin oil of thin body and easily oxidizable properties, which would be very objectionable when used in a light-colored axle grease. The test for the rosin is to take a piece about the size of a pea and crush it to a powder. Genuine gum rosin, no matter what the grade, will give a white powder. If there is a tendency to fail to grind to a dry powder, or the powder is yellow or brown, let the rosin oil manufacturer beware. The acid number of a good grade of gum rosin should run around 162. This for the benefit of the man who wants to give a technical turn to his specifications.

Paper read before the Symposium on Rosin, Twenty-Ninth Annual Meeting of the American Society for Testing Materials, Atlantic City, N. J.

Complete Gasification of Coal

Adoption of this process depends on economic balance of solid and gaseous fuel prices and probably fluctuations in gas demand

By R. S. McBride
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COMPLETE gasification of bituminous coal is usually intended by gas engineers to mean the processing of a coal with production of only gas and ash. A wide variety of apparatus has been proposed for this purpose, some single shell generators and others with two or more generating chambers. But in every instance the combination is intended to utilize for low-temperature coking of the coal the heat generated during the final gasification of the coke.

In a general sense complete gasification should include any process or combination of processes which converts substantially all of the bituminous coal into fuel gas without manufacturing coke as an end product. In this broader sense the gas producer and the water-gas machine when using bituminous coal are complete gasification devices. The combination of any coal-gas unit with a water-gas machine using the coke also affords complete gasification; and even the steaming of coke in a coal-gas unit may, at least theoretically, go a long way toward complete gasification of the coal. None of these schemes are, however, commonly referred to as complete gasification, but it appears that any profitable discussion of the subject should include them.

Why the Gas Man Is Interested

The engineer of a public-service gas company must necessarily think in terms of unit costs per thousand cubic feet of gas made and sold. Such an engineer may be technically much interested in the by-product problem, but his major objective in considering such materials is the lowering of the net cost of the gas. Furthermore, such a utility company engineer is desirous of using as his raw material bituminous coal, because this is the lowest and most stable in cost of all of the gas-making materials available to him. It is logical, therefore, that he should seek to make from the preferred raw material, bituminous coal, as much as possible of the principal product desired, city gas, and that he should seek to avoid making other products which at least indirectly represent annoyance and diversion of attention from the major job of city-gas supply. It is not surprising under these circumstances that gas engineers have at all times regarded with even greater interest than the commercial prospects would warrant any new suggestion for "complete gasification."

Although the committee on this subject has reported briefly at each recent annual meeting of the American Gas Association, it has been several years since any of these committee reports has dealt broadly with the question of trends in the industry. This report, therefore, was prepared as an attempt to summarize briefly the present status and trends in "complete gasification," using the term in its broadest sense.

Abstract of report presented at Fall Meeting, American Gas Association, Atlantic City, N. J., Oct. 11-14.

A number of complete gasification processes have been tried out in the United States on a commercial scale. However, at the present time none of these appears to be operating for the production of city gas.

In Europe there are, on the contrary, a number of processes operating on a commercial scale for this purpose. Apparently, none of these foreign developments has found the economic situation in the United States favorable for similar development. This is probably largely the result of the difference here and abroad in the relative prices of bituminous coal, coke, anthracite, oil, and low-grade fuels. With the constant threat of increasing cost of gas oil and the more serious threat of its total unavailability, this situation may change somewhat. But it is not profitable to consider here how soon or to what extent these changes may come to pass. No generalizations on this subject are feasible, for in every locality many distinctive conditions must be taken into account by the management in determining when any change, and then what change, should be made.

In previous reports to the American Gas Association there have been descriptions of the Strache "Double-Gas" process, the Tully process and several other processes that have found the widest application in Europe. Nothing has been noted in recent engineering literature to indicate that any basic changes have occurred in these or similar processes which necessitate consideration at present.

Several American developments have also been considered in earlier reports. Among those most frequently and conspicuously mentioned have been the Doherty, the McDonald and the Wilcox. Apparently the last named has been used only on low-grade Western bituminous coals and lignites; and the other two are not, so far as the present author is aware, being used at any point commercially, either for city-gas or industrial-gas supply. The most extensive trials of both the Doherty and McDonald processes have been with the idea of manufacturing industrial fuel gas. But as yet neither process has passed out of the development stage to the point where its backers are undertaking further installations.

One new process of complete gasification which has been brought to the attention of American engineers during the past year is the Kreisa process which has been utilized at several European works with a wide variety of English and Continental gas coals, lignite, brown coal, etc. After study of European conditions and successes an American company has taken over the American agency for this process and at the present time is working on designs suited to American conditions. Estimates of the applicability of this process to American fuels and American gas-works conditions have been made by this company; but the work has

not progressed to the point of affording commercial trials or actual operating figures.

The Gas Producer, the Simplest Complete Gasification Unit

Complete gasification of bituminous coal has long been successfully accomplished by means of the gas producer. No variation of this process has, however, yet been useful for public-utility companies because of the very low heating value of the gas. Even in the field of industrial supply the low investment cost and simplicity of operation have very often been more than offset by the poor flame characteristics of producer gas or the high cost of regenerative or recuperative equipment necessary because of the high percentage of inerts in the gas.

When it was proposed that oxygen be used for producer gas making, the public utility gas man again found interest in the gas producer, since when using an oxygen blast the producer would make a gas from bituminous coal comparable in heating value and flame characteristics with blue water gas made from the same fuel. However, it has been found that the cost of oxygen for gas making is likely to remain prohibitive for some time to come and this possibility in complete gasification again passes out of the field of economic interest.

Bituminous Coal for Water Gas

The greatest success in complete gasification of coal without use of coal-carbonizing equipment has been had through utilization of bituminous coal as water-gas generator fuel. The results now widely realized indicate that millions of tons of bituminous coal will undoubtedly soon be processed by this means. Thus complete gasification is being achieved in fact, if not in name.

The result of this method of treating bituminous coal is a gas which closely resembles in heating value and flame characteristics the form of blue water gas which has previously been well known. The product does contain substantial percentages of the gases resulting from low-temperature distillation of the coal, but with most efficient operating methods the increase in heating value thus caused is offset by increased amount of inert diluents, especially when the blow-run system is used. Because of the low heating value of the gas from this system of complete gasification the uncarburetted water gas from bituminous coal does not yet offer attractive prospects for city supply alone. Hence, despite the improvements which have been made in operating cycle, such as the back run, the down-run, etc., and the advantages involved in the Pier process, such uncarburetted water gas from bituminous coal is not yet actively a candidate to replace other sources of city supply. It does not, therefore, afford the gas engineer that relief from dependence upon gas oil which has been sought.

The gas engineer, by some such process of reasoning as above outlined, usually reaches the conclusion that neither the gas producer nor the water-gas machine affords means for using bituminous coal alone as raw material. He then of necessity must decide whether he will add oil gas, by some scheme of carburetting, or will first process the coal for the manufacture of coal gas and then use only part of the coke in water-gas or producer operations. In either event he is likely to find his ultimate decision based upon the relative cost per million heat units in the gas.

At this point it is worth while again to emphasize that the ultimate criterion of economy for the city gas system must be the cost per million heat units delivered at the customer's premises. For industrial gas supply the factory manager may consider the cost per million heat units in the holder; but for a public-utility system this may neglect very important considerations and final decision cannot be safely reached on the basis of net holder cost per million B.t.u. This fact is well recognized by many engineers, but its neglect has occasionally resulted in false conclusions for public utilities because of the relative greater cost for distributing gases of higher specific gravity or of lower heating value per cubic foot.

When oil is cheap enough so that either the net holder cost or the delivered cost to the customer is lower per million heat units in carburetted water gas than with a mixture of coal gas and water gas, the gas engineer then retains at least the semblance of complete gasification of the bituminous coal, for he does not turn to coal gas with its consequent manufacture of coke. But, as pointed out so clearly by J. A. Perry at the 1925 Convention of the American Gas Association, the preferred result for the country as a whole, so far as generalizations are possible, appears likely to be a combination of coal-gas base load with blue water gas, or even producer gas, admixture, all under conditions that will permit uniform specific gravity and reasonably uniform heating value throughout the year despite large changes in load.

Steaming of Coal-Gas Units

To give increased gas output per ton of coal processed and to accomplish other important improvements in plant operation many attempts have been made to steam the coke within a retort or oven. These practices are even more extensively employed abroad than in the United States and seem to be again growing in favor in this country. Among the arguments advanced are the increase in gas yield with a given investment and a given amount of labor; increase in yield of certain by-products, notably ammonia; and, in some types of apparatus, an improved heat distribution throughout the carbonizing chamber. In no case, however, has it proven at all practical to extend the steaming of retorts to a point that even approaches complete gasification. Such a scheme is far less economical than the combination of retort with water-gas set. And, of course, the mixture of coal gas with the blue gas from such complete steaming would be of the same low heating value as that from other complete gasification schemes.

This question of heating value limits is an important one to any engineer seriously considering complete gasification. It still remains customary in most parts of the country to require well over 500 B.t.u. per cubic foot in the gas distributed; and so long as standards of this order are maintained there is no chance for using complete gasification units or combinations producing complete gasification unless some means of enrichment of the resulting gas is employed. On the other hand it should be clearly understood that the gas company and the customer are both best served when a heating value is chosen which will permit the delivery of the maximum number of useful heat units for each dollar paid by the customer. Under these

circumstances the cost of gas service is the lowest to the customer; and the company obtains its fair return upon investment in the least painful way.

There is obviously no generalization possible as to the heating value at which the maximum efficiency is attained. This optimum point varies with many factors and is probably much higher for many cities than for others under apparently similar conditions. It is probably safe to say, however, that any company which can demonstrate its ability to lower the cost of a million heat units to its customers by lowering the average heating value delivered will find the public authorities who fix standards very willing to co-operate to this end. It is fair to generalize, therefore, that the existence of present heating value standards, generally lying between 500 and 600 B.t.u. per cu.ft., is only a temporary obstacle to complete gasification and one easily removable under any circumstances where a sound demonstration can be made that lower heating values afford real economy.

Combining Coal-Gas and Water-Gas Units

Whether the combination of coal gas with water gas be made as suggested by Perry or by the more conventional means which have been adopted in 150 or more gas works in the United States that today distribute mixed gas, the carbonizing unit should carry most of the base load of the business. This is necessary because of the difficulties involved in starting up and shutting down coal-gas units, whether of the retort or of the oven type, and because of the greater unit investment in such apparatus, which makes the financial penalty of idleness so much greater. The starting point in blending of gases is, therefore, a more or less fixed output of oven or retort gas, usually of about 570 B.t.u.

Variation in production of this gas was formerly limited by the extent to which the bench or battery could be slowed down or speeded up through changes in heats and changes in coking time. The maximum variation in output under those circumstances was necessarily small; and not until the double system of heating ovens was developed did it become possible within a short period of time to change quickly from about 60 per cent to about 110 per cent of normal capacity in coal-gas units. After trials at its Seaboard and Chicago plants the Koppers Co. first applied this system in convenient form at Battle Creek, Mich., on their Becker ovens. In that plant any number of ovens can be quickly changed at the will of the operator from oven-gas firing to producer-gas firing, or vice versa. Subject to the limitations of patents still in force, this general idea may eventually be adopted for new installations of other oven and retort systems, of course with suitable modifications of the conventional flue and regenerator systems.

But even with this greatly increased flexibility in production it is not feasible to meet the seasonal changes in gas requirement for all cities with coal-gas equipment alone. The most economical addition of gas-making equipment is commonly a blue-gas or carburetted water-gas generator using coke as solid fuel. The quantity of blue gas which may be added is determined in part by the changes in demand, but the maximum quantity which can safely be added is very definitely limited by the requirement of a reasonable uniformity in the performance of the gas at the customer's appliance. To some extent variation in heating value, variation in pressure, variation in specific gravity of gas, and variation in chemical composition can be made to offset one another and to produce uniform appliance behavior. But with large variations in the percentage of blue gas added from one day to another or from one season to another, troubles will multiply.

This problem, which has been sufficiently acute in the past, is becoming still further aggravated by the problems of gas for house heating. This demand threatens to multiply cold weather requirements to 12 or even 20 times the summer gas requirements. Recognizing the impracticability of furnishing gas with so wide a variation of load without very radical changes in both manufacturing and distributing methods, many far seeing engineers have worked against complete gasification ideas and have urged that the gas company seek to supply not alone gaseous but also solid fuel in the form of coke. By this means it is hoped that the burden of household heating loads may be carried by coke, for the present at least. The excessive fluctuation which would otherwise be imposed upon gas would thus be postponed until such time as the company as a whole is ready to meet it.

With the constantly increasing prices for anthracite and the constant urge for smokeless fuels, coke for house heating is likely to be in steadily growing demand. To the extent that this demand does increase it will work against complete gasification. But it will also work greatly to favor those city gas companies which use coal gas from any type of equipment as the base load and which utilize water gas only or primarily to satisfy the highest peaks of demand.

Manufacturer or Public Utility

Confronted with these problems the management of a city gas system is often at the parting of ways between a purely manufacturing business and a purely public-utility business. There is certainly nothing inherent in the manufacture of coke and by-products which makes this a typical "natural monopoly" and consequently logically a public-utility business. And yet under the present system of utility cost keeping the business of making and selling coke, tar, light oil, and ammonium sulphate by a gas works may be as intimately supervised as the making and selling of the gas itself.

Reasoning from these premises opponents of complete gasification argue that a well managed concern doing business as a manufacturer of coal products is needed to replace the public-utility management so far as the production department is concerned. Such a concern would be at liberty to buy its raw materials and sell its products by any scheme and with any system of cost keeping that was appropriate for any manufacturer making a variety of products. In such an establishment each product would be expected to carry a reasonable share of the overhead, including capital charges, and could reasonably be asked to return to the owners a share of the total profit expected.

It appears that this trend toward the establishment of coal-processing works as multi-product manufacturing establishments is an important one. There is, however, no means of appraising the rate at which it will be effective nor the extent to which ownership and management may be common with the companies which are essential public-utility city-gas distributing concerns. The trend, however, must be recognized as probably the most important single influence working against increases in complete gasification.

Electrodeposition of Zinc, Copper, Cadmium and Iron

American Electrochemical Society symposium and discussion reflects increased scientific interest in electroplater's art

Editorial Staff Report

GROWING interest in the technology of electrodeposition, stimulated in recent years by new scientific and commercial achievements in chromium plating, contributed greatly to the success of the technical session on electrodeposition, held under the chairmanship of Dr. William Blum during the recent Washington meeting of the American Electrochemical Society. Following presentation of eight papers on the electrodeposition of zinc, copper, cadmium and iron, there was an enthusiastic roundtable discussion on "Preparation for Electrodeposition." Professor E. M. Baker of the University of Michigan and consulting chemical engineer for the C. G. Spring and Bumper Co., presided at the roundtable, which was well attended by representatives of the electroplating industries.

In the first paper Dr. M. R. Thompson of the Bureau of Standards reported his investigations of acid zinc plating baths. He did not find it possible to increase materially their throwing power, chiefly because of the low cathode polarization which they possess. It was found, however, that simple baths of much higher conductivity than those commonly used may be prepared, in which satisfactory deposits can be produced at unusually high current densities. Such baths may contain a moderate concentration of zinc chloride (e. g. 2N); a high concentration, e. g. 3 to 4 N of sodium or ammonium chloride, and a small concentration, e. g., 0.25 N of aluminum chloride. These baths operate best at a pH from 3.5 to 4.5.

In commenting on Dr. Thompson's work, Stuart J. Colvin of the General Motors Corporation called attention to the great need of a sulphate bath with high throwing power since the cyanide bath was very destructive on the parts of the plating barrel. The amperage of the plating plant of the General Motors Corporation was about 50,000. Dr. Thompson believed that many so-called failures in the salt-spray test of electrogalvanized parts were due to low or poor throwing power of the solution. The recesses of the work received little or no zinc deposit. As to the addition of chloride to the bath, George B. Hogaboom of the Hanson Van Winkle Co. felt that this would raise the percentage of lead (from impure zinc anodes) in the bath. Frank F. Farnsworth of the Western Electric Co. found that any chloride from the bath occluded in the deposit would shorten the useful life of the coating.

A very instructive set of experiments was presented by Professor E. A. Vuilleumier. By coating the cathode with a film of glycerine, sugar solution, or even water, relatively dense, smooth, adherent deposits of lead and of silver are obtained from solutions which normally give rise to very "unsatisfactory" deposits. This is probably due to the formation of many nuclei in the early stages of deposition.

Dr. W. C. Moore of the U. S. Industrial Alcohol Co. suggested the use of ethyl lactate or tartrate. Mr. Hogaboom cited a case that occurred during the war. In order to obtain smooth lead deposits on the inside of gas shells, using the fluosilicate bath, the brass surface was given a preliminary coating of glue. Later Dr. Blum recommended the fluoborate bath and this required no such preliminary step.

Value of Addition Agents

A contribution from Japan was a careful analytical treatment of the "Common Properties of Addition Agents in Electrodeposition" by Giichiro Fuseya and Kwanji Murata of the Tohuko Imperial University. Among other things, it was found that those substances which increased the weight of the copper cathode deposit tend to reduce the size of the crystals in the deposit, whereas substances which do not vary the crystal size cause no increase in the weight of the deposit for the same amount of current. The formation of complex ions upon the addition of various substances to the electrolyte was carefully investigated by electromotive force and ion migration measurements. The experiments showed that both copper and silver formed complex ions with metaphosphoric acid, tartaric acid and glycocoll, which are positively charged. In general, oxy-acids and amino-acids have the common properties of forming complex cations with copper or silver ions. These are the very substances which entered into the cathode deposits and caused the crystal size to be smaller. On the other hand, sugars and the higher alcohols do not form complex ions with copper or silver, or do so only to a slight extent, and these substances do not in any way or only very slightly affect the cathode deposit. There appears to be a close relation between the property of forming complex ions and that of diminishing the size of the cathode crystals.

S. Skowronski of the Anaconda Copper Co., in commenting on the above findings of the Japanese investigators, stated that with a given addition agent we might obtain an increase in weight in a neutral solution but would not necessarily get the same result in an acid solution.

"Voltage Studies in Copper Refining Cells" were reported by Colin G. Fink and C. A. Philippi of Columbia University. A number of curves were shown suggesting more efficient operating conditions than those prevailing in most plants today. Paul K. Aubel and J. B. Mahool, Jr., of the Baltimore Copper Refinery (A. S. & R.) did not believe the suggested change in the con-

centration of the electrolyte to be practical and considered 200 grams per liter of acid far too high. On the other hand S. Skowronski reported that a few years ago the Anaconda company had adopted the higher acid concentration and had even gone up to 220 grams per liter at the Great Falls plant. Careful tests at various plants are still under way and will shortly be reported upon.

Electrochemistry of Manganese

The electrochemistry of manganese has within recent years attracted considerable attention. The electrolytic production of permanganate has been the subject of a number of papers. Investigations in England covered the electrodeposition of manganese. The latest contribution emanates from the Kahlenberg laboratory, University of Wisconsin: "The Electrode Potential and Replacing Power of Manganese," by Harvey D. Royce and Louis Kahlenberg. Electrodes of manganese amalgam were prepared, whose surface could be continually renewed by stirring, taking particular pains to omit all oxidation. Good reproducible potential values were obtained, which values are several hundredths of a volt higher than those reported by Neumann. In normal sulphate, the potential for manganese is 1.449 volts. The effect of the concentration of the manganese in the amalgam was investigated. The potential of the amalgam increases as the per cent manganese in the amalgam is increased, until a value of 1.45 volts is obtained at a concentration of 1.2 per cent manganese in the amalgam. From there on, further increases in the manganese content result in no change in the potential value of 1.45. Manganese will replace out of solution other metals, whose potentials are more noble than that of manganse, including zinc, cadmium, iron, cobalt, nickel, lead, copper and silver.

Rustproofing with Cadmium

Clayton M. Hoff of the Grasselli Chemical Co. gave an account of the new method of rustproofing iron and steel by electroplating with cadmium. Discussing Mr. Hoff's results, Henry S. Rawdon, physicist of the Bureau of Standards, reported that cadmium plated machine parts had been tried out at McCook field and that a plate of Cd 0.0003 inch thick was more satisfactory than a plate of Zn 0.001 inch, or more than three times as thick. Threaded parts required no undercutting before plating. Frank F. Farnsworth of the Western Electric Co. stated that outdoor corrosion tests on cadmium and zinc-coated iron sheets resulted in early darkening of the Cd-plated sheets, although this discoloration may not have anything to do with the life of the plate. Mr. Hoff added that whereas in the case of Zn, doubling the thickness doubled the life, in the case of Cd plating, doubling the thickness of the Cd deposit more nearly quadrupled the life of the sheets. George B. Hogaboom of the Hanson Van Winkle Co. and government expert on practical plating stated that he had found no advantage of Cd over Zn. Mr. Van Winkle Todd, president of the company, mentioned that it had been difficult to advise customers as to the relative merits of Cd and Zn due primarily to lack of reliable cost figures of the two processes. Dr. Fink added that the field for cadmium and zinc was quite distinct from the field for chromium plating. The hard mirror surface and good wearing qualities of chromium were among its chief attractions. Mr. Hoff displayed a number of Cd plated samples that had an appearance almost that of silver. The Udylite company had parts of a Cd-plated steel casket on display.

"Some Properties of Electrolytic Iron," by G. Prescott Fuller, covered the latest data on the electrolytic tube production of the Niagara Electrolytic Iron Co. The composition of these tubes is

	Per Cent		Per Cent
C	0.006	P	0.005
S	0.004	Cu	0.015
Si	0.005	Mn	0.000
Fe by difference	99.965		

The S, Si and P run practically constant. Carbon and Cu are the principal variables, C due to conditions in the electrolyte, and Cu due to the impossibility of securing anodes and scrap iron free of this element, or containing it in constant proportions. It is possible to reduce the Cu content to 0.004 per cent, but only at increased trouble and expense. The carbon content is the factor which chiefly influences the properties of the metal. The presence of copper is ordinarily in no way detrimental, and may be beneficial in respect of its resistance to chemical corrosion, and also in improving the working properties of the metal.

In working electrolytic iron it is possible to take greater reductions per pass, and more passes between anneals, than is possible in the case of mild steel. This property, coupled with the ability to quench at once after annealing without hardening, makes the metal peculiarly adapted to cold working both in drawing and in deep stamping.

In respect of the resistance of electrolytic iron to chemical corrosion it may be stated that in non-oxidizing solutions electrolytic iron is about three times as resistant as dead soft steel, while in oxidizing media there is little, if any, difference between the two. The presence of copper in electrolytic iron seems to increase its resistance to corrosion slightly.

Robert Turnbull stated that the production at Niagara Falls amounted to 7 to 10 tons of tubes per day. Dr. Fink pointed out that the remarkable mechanical properties of pure electrolytic iron are shared by other pure metals such as cobalt, nickel and copper.

A New Corrosion Theory

A theory regarding the passivity and corrosion of iron was presented by Leon McCulloch of the Westinghouse Electric & Mfg. Co. The progressive rusting of iron was ascribed to the "catalytic" action of soluble iron salts, which are held upon the iron surface by the coating of rust. These soluble iron salts are a product of the electrolytic action, which takes place over the surface of a metal when exposed to natural waters and air. Thus the modern electrolytic theory and the old acid theory are combined into one, but the carbon dioxide to which the corrosion was attributed by the old acid theory is no longer necessary, since iron salts of stronger acids are seen to be present.

Junius D. Edwards and Cyril S. Taylor of the research bureau of the Aluminum company investigated the effect on the electrical resistivity of aluminum caused by the addition of calcium up to about 4 per cent. The addition of 3 per cent calcium increases the resistivity of rolled aluminum from about 2.70 to 3.30 microhm-cm. The structural arrangement of the aluminum-calcium constituent in the cast alloys satisfactorily explains their somewhat higher resistivity.

Marketing Alums and Aluminum Salts

Describing the methods used in producing these chemicals and in distributing them among consuming industries

By F. J. Curtis
Chemical Engineer, Merrimac Chemical Co.

THE PRINCIPAL compounds of aluminum used in the industries at the present time are sulphate of alumina commercial and iron free, chloride of alumina liquid, crystal and anhydrous, and the group of true alums, potash, soda and ammonia. Of these by far the most important is the sulphate of alumina, ordinarily called "Alum."

Sulphate of Alumina

Sulphate of alumina has at various times been called patent alum, aluminous cake, burnt alum, etc. These names refer to various grades and degrees of purity of aluminum sulphate. Commercial sulphate of alumina corresponds roughly to the following: $Al_2(SO_4)_3.17\frac{1}{2}H_2O$. It comes both in the commercial and iron free grades. Representative analyses are as follows:

	Commercial Per Cent	Iron Free Per Cent
Al_2O_3 total	17.5	17.5
Al_2O_3 combined	16.3	16.4
Al_2O_3 basic	1.2	1.1
Fe_2O_3	.02	.007
FeO as Fe_2O_3	.58	.....
Insoluble	.15	.10

In addition to these there is also a product usually called slab alum or aluminous cake which is of a lower alumina concentration corresponding to 15.2 per cent Al_2O_3, the chief difference being in the water content.

Sulphate of alumina is furnished to the trade in a number of different sizes depending on the real or fancied needs of the consumer: Ingot—comprises lump material from 1 in. to 2 in. in size; nut—ranges from ½ in. to 1½ in.; ground—is minus 8 mesh product. There are also pea and rice sizes which are specialties and others may be made for particular cases. Slab alum usually comes in rectangular cakes 6 in x 6 in. x 18 in. weighing 40 lb. Burnt alum is formed from the crystal by the elimination of water and contains, therefore, the alkali content of the crystal alum.

The use of alum, of course, depends upon business conditions in the consuming industries. However, a survey of its consumption over a period of years shows no regular seasonal variation. In 1923 there was consumed in the United States 272,415 tons of this material which was increased to 284,670 tons in 1924. Later figures are not yet available. This consumption will probably increase slowly as water filtration becomes more prevalent with the increase in population. However, the migration of newsprint mills to Canada may have a tendency in the opposite direction. Water filtration and the sizing of paper account for the greater part of the consumption of sulphate of alumina. Other uses are the manufacture of satin white, a paper coating material, color lakes, as a mordant in dyeing, for sewage treatment, for deodorizing mineral oils, hardening plaster casts, recovering glycerine from soap lyes, and in manufacturing other aluminum salts. *Chem. & Met.* in its annual review January, 1926, gives the distribution of sulphate of alumina as follows: water purification, 60 per cent; paper, 35 per cent; all others, 5 per cent.

In the purification of water a solution of sulphate of alumina is added in a concentration of about one to two grains per gallon to the raw water. After a variable period of sedimentation the water is filtered and is ready for the consumer. The alum forms a flocculent precipitate with the natural or added alkalinity which drags down the impurities. For the sizing of paper both rosin size, an alkaline solution of rosin, and silicate of soda are used. The sizing agent is added to the beater in making up the batch; alum is then used to precipitate the size on the fibre in a very intimate manner.

Sulphate of alumina is very widely distributed as would be natural in a product of which the largest proportion goes into water treatment. However, most of the water treatment plants are in the eastern half of the country, a condition which later will undoubtedly be changed. For similar reasons sewage treatment is localized in the neighborhood of the large cities. The paper industry is particularly concentrated in New England, New York, Canada, and northern Middle Western states, although the South may in the future see an expansion of the industry recently started there.

Sulphate of alumina properly manufactured is noncorrosive, nor is there any fire hazard, and it can therefore be shipped without special labels or restrictions. It is furnished in slack barrels, in bags, and in bulk. Both barrels and bags are usually paper lined, although with the lump material this precaution is sometimes omitted. A barrel weighs 400 lb. gross, 376 lb. net and occupies a space 24 in. square, 29 in. high or approximately 9.67 cu.ft. A bag has a gross weight of 184 lb., net 182 lb. for a single bag, and a net of 200 lb. for a double bag. In each case the space occupied is 15 in. square, 30 in. high with a cubic capacity of 3.91 cu.ft. The slabs are usually sold in bulk.

The price is based on the alumina content of 17 per cent to 17½ per cent for the ordinary commercial or iron free sulphate of alumina, and 15 per cent Al_2O_3 for the slab alum. Most users contract directly with the manufacturer, usually but not entirely, in the fall months. Prices are ordinarily quoted f.o.b. works in dollars per 100 lb. The average prices from 1894 to date for the commercial and iron free grades are as follows:

Year	Commercial	Iron Free	Year	Commercial	Iron Free
1894	$1.25	$1.75	1920	$2.65	$3.50
1901	1.35	1.75	1921	2.25	3.15
1911	.90	1.75	1922	1.65	2.75
1913	.90	1.25	1923	1.50	2.60
1917	3.50	....	1924	1.30	2.25
1918	2.25	4.00	1925	1.30	1.90
1919	1.86	2.87	1926	1.40	1.75

This shows the expected rise in prices at the beginning of the War and the falling off due to its cessation followed by the rapid rise in the boom of 1920. Since

then prices have steadily declined. However, it is worthy of note that if $1 in 1913 equals $1.60 in 1926 then alum at $1.40 in 1926 costs no more than at $0.90 in 1913. Iron free alum has gone through the same cycle as the commercial variety and is being forced still lower at present by foreign competition.

There is no deterioration of alum on storage if it is kept on the basic side in its manufacture and if there is no possibility of wetting. When the latter takes place a certain amount of acid formation rots the bags or barrels, and the wetting allows the oxidation of the ferrous iron to ferric causing discoloration and difficulties if used for paper making. Alum is sold in all quantities from one bag or barrel to carload lots.

In 1923 there was a total of nineteen plants manufacturing commercial alum of which fifteen were for the general industry and four were municipal. This number was increased in 1924 to a total of twenty-five plants, nineteen for general use and six municipal. During the same periods the number of plants for the manufacture of iron free alum increased from five to seven. Many manufacturers of sulphate of alumina are also large producers of other chemicals. There are, however, several important plants devoting their entire attention to this product. Due to its large consumption of sulphuric acid it works out very well in conjunction with the manufacture of this commodity.

The figures for production as given by the Tariff Information Bureau and the Mineral Resources of the United States are as follows:

	Tons		Tons
1915	169,153	1920	234,003
1916	153,860	1921	184,813*
1917	178,738	1922	281,480
1918	209,079	1923	289,904
1919	200,034	1924	302,190

* Includes true alums.

Production has shown a steady increase and corresponds quite closely to the domestic consumption. As there are at present no alum plants in Canada the producers will not be specially handicapped by the moving of the newsprint industry out of the United States, although competition in the Canadian district is keener since European business conditions have become more stabilized. The producing centers are widely distributed, being perhaps chiefly in New York, New Jersey, Cleveland, Illinois, Philadelphia, St. Louis, Albany, Indiana, Tennessee and Boston.

The raw materials used in the manufacture of alum are principally bauxite, an impure hydrate of alumina, clay and the pure hydrate of alumina. Bauxite is chiefly found in the United States, Dutch and British Guiana, France and Ireland. A typical analysis of the material from these sources is as follows:

	Ireland	France	Guiana	United States
Al_2O_3	41.08	64.18	60.30	51 – 60
Fe_2O_3	3.21	3.47	1.82 3.85	2 – 3
TiO_2 SiO_2	33.17	18.96	3.34	4 – 16
H_2O (comb)	22.54	13.39	30.69	25 – 26

The production in the United States in 1924 was 346,553 long tons from Arkansas, Georgia, Alabama and Tennessee of which 326,616 tons came from Arkansas. This is a decrease of 34 per cent from the figures of 1923. Nearly all of the bauxite imported comes from Guiana which sent in 1924 201,974 long tons. The apparent domestic consumption of bauxite is 471,462 long tons. The domestic bauxite is distributed as follows: 65 per cent, manufacture of aluminum; 15.8 per cent, manufacture of chemicals; 19.2 per cent, manufacture of abrasives and refractories. The average price in 1924 was $13 per ton delivered at the plants.

China clay occurs chiefly in England, France, Austria and the United States. Only a relatively small amount of the alum manufactured in this country is made from china clay. The iron free alum is made from pure hydrate of alumina containing no iron. There are two chief producers in the United States and the output in 1924 was 5,180 tons.

Sulphate of alumina has been manufactured for a great many years and the methods in use are pretty well standardized. The bauxite process consists of the digestion of bauxite and acid, the separation and washing of the insoluble residue and the evaporation of the clear liquor. Digestion may be in an open tank or in a pressure digester. Separation may take place by settling or filter pressing or both. Within the last few years the Dorr continuous apparatus has been adapted for carrying on the first two steps of the process with success. In this manner acid and bauxite are delivered continuously to one end of the system and a strong liquor overflowed at the other end ready for evaporation. If manufactured from clay, the clay is calcined until nearly water free. It is then dissolved in sulphuric acid forming alum cake which may be sold as such or redissolved and purified. If manufactured from hydrate, the process is simpler as there is no insoluble matter to be removed. It simply consists of digestion and boiling down which may be carried on in one operation. The hydrate itself is chiefly obtained from bauxite by processes whereby the bauxite is treated with soda ash or caustic soda to form sodium aluminate from which the aluminum hydrate is then precipitated, or it may be obtained in the Cryolite Process for the production of soda ash. Foreign competition forcing down alum prices may result in a more intensive study of the process of manufacture and further improvements, but the general outlines of the process seem to be too fixed to admit of radical changes.

Since the War the foreigner has returned to the United States market chiefly with an iron free product. It is the opinion of many American manufacturers that this material is being sold at figures below cost abroad, and that European profits are being temporarily sacrificed to obtain a place in the American market. Competition in the Canadian market has also been intensified, but the bulk of the commercial alum business still remains in American hands. It is evident that with their lower wages, longer hours of labor and willingness to sacrifice, the Europeans will make a strong bid to increase their American tonnage.

The statistics on imports are not any too reliable, authorities giving widely different figures. The export figures, however, are trustworthy and for recent years are as follows:

Year	Pounds	Amount	Year	Pounds	Amount
1922	26,450,657	$388,447.00	1924	32,024,332	$407,768.00
1923	35,490,560	504,292.00	1925	35,737,542	437,950.00

These show a fairly steady condition without great change. The larger portion of this material is exported to Canada and the figure would probably be substantially increased as the paper industry moves north were it not for foreign competition. On account of this latter factor we may find an actual falling off in the exports.

The imports as given by the Tariff Information Sur-

vey and the Department of Commerce are as follows:

Year	Pounds	Amount	Year	Pounds	Amount
1918	465,996	$14,751.00	1923	511,276	$8,049.00
1919	686,579	21,877.00	1924	696,365	9,045.00
1920	2,678,846	68,035.00	1925	1,607,973	17,246.00
1921	1,280,329	33,285.00 (9 mo.)	1926	1,181,036	12,166.00 (1st half)

These figures show that the aluminum sulphate industry in the United States has been heretofore nearly free from foreign competition and is at present supplying practically the whole domestic consumption.

The Fordney Tariff classes potash and ammonia alum and aluminum sulphate containing not more than 15 per cent Al_2O_3 or 0.1 per cent Fe_2O_3 together with a duty of 0.3c. per lb. Aluminum sulphate containing more than 15 per cent Al_2O_3 and not more than 0.1 per cent Fe_2O_3 has a duty of $\frac{3}{4}$c. per lb. All other aluminum compounds are taxed 25 per cent ad valorem. This duty of 37$\frac{1}{2}$c. per 100 lb. is inadequate to prevent importation of iron free alum by foreigners in this market.

In the paper industry no substance has been found which will give the same results as aluminum sulphate in precipitating rosin in the sizing of paper. It is a moot question whether the alum acts chemically by combining with the rosin to form aluminum resinate or whether the acidity precipitates the rosin from its alkaline solution, but experiments have shown that the addition of acid will not give the same results.

In water purification ferrous sulphate is used to a certain extent although there are very decided disadvantages connected with it; lime is required for precipitation and if not added carefully may cause an after-precipitation. Ferrous sulphate cannot be used with highly organic colored water since the organic tannates and gallates form inks. An excess of lime causes the presence of caustic lime in soft waters. Sodium aluminate seems to be coming slowly to the fore as a competitor for alum under certain conditions. When the natural alkalinity of the water is insufficient to precipitate aluminum hydroxide from the alum, it is necessary to add some alkali, usually soda ash, to effect this. Under these circumstances sodium aluminate provides both alkali and alumina in the same molecule at a very considerable saving in chemical costs. In its special field it will probably decrease the use of alum.

As the sulphate of alumina industry is a widely distributed, highly competitive one prices are kept at a minimum. Foreign competition may push this general price level still lower and may eliminate a few of the smaller producers. The industry, however, is important enough from the standpoint of public health, manufacture of paper, and consumption of sulphuric acid so that there is little doubt of its continued gradual increase in the future.

Chloride of Alumina

Chloride of alumina occurs in the liquid, crystal and anhydrous forms. The liquid is obtained by the action of muriatic acid on hydrate of alumina, the crystals by the evaporation or precipitation of the liquid solution, and the anhydrous by the action of chlorine on alumina in the presence of carbon. These materials are usually sold on the basis of their alumina content which is as follows: Liquid, 10.4 per cent, Al_2O_3; crystal, 20.7 per cent, Al_2O_3; anhydrous, 38.6 per cent Al_2O_3. The production is not large and was as follows:

Year	Producers	Tons
1919	7	4,265
1921	8	4,351
1923	8	4,706

Four of these plants were in Pennsylvania, the others being in Connecticut, Massachusetts, New Jersey and West Virginia.

The chief uses of chloride of alumina are in the carbonizing of wool and the refining of petroleum. Wool as obtained from the sheep contains variable amounts of vegetable matter such as burrs, seeds, etc. In order to remove this the wool, either in the raw state or in the piece, is saturated with a weak solution of sulphuric acid or chloride of alumina and then heated. The acid hydrolyzes the vegetable matter which is easily shaken out. Chloride of alumina, although more expensive, has the great advantage of being used in a neutral solution so that dyes are unaffected by it. Furthermore, the wool is given a better color and a softer feel.

Chloride of alumina used for the refining of petroleum is in the anhydrous form. When certain mineral oils are treated with aluminum chloride some of the hydro-carbons combine with the latter. When distilled, hydro-carbons of a lower boiling point are produced. Also certain distillates containing olefines polymerize to give lubricating oils. Furthermore, in many cases aluminum chloride has a desulphurizing action. As a cracking process, however, chloride of alumina does not seem to be making as much progress as the pressure methods.

The liquid chloride of alumina is sold in carboys weighing 140 pounds net. The crystal and anhydrous forms are sold in barrels weighing about 375 lb. net. The present prices are $3.50 per hundred pounds for the liquid, $6.50 per hundred pounds for the crystal and $15.50 per hundred pounds for the anhydrous in carload lots.

Alums

The true alums are combinations of aluminum sulphate with the alkali sulphates. They are very similar in their nature and uses. The soda alum is difficult to crystallize free from iron and is less used than the others. They are all practically 100 per cent pure.

Production in recent years has been as follows:

Year	Producers	Tons	Year	Producers	Tons
1914	....	64,355	1921	12	14,821
1919	....	19,512	1923	12	14,978

Potash alum is produced in California, New York, Pennsylvania and Illinois, ammonia alum in New York, Pennsylvania and Massachusetts, and soda alum in New York, Missouri and Illinois.

The prices for ammonia alum are given by trade publications as follows:

Year	Per 100 Lb.	Year	Per 100 Lb.
1881	$2.15	1913	$1.75
1891	1.50	1918	8.00
1901	1.75	1924	3.50
1911	1.75	1925	3.50

No separate record of exports can be found. Imports are given as follows: ammonia alum, 1924, 254,075 lb., 1925, 79,371 lb.; potash alum, 1924, 2,566,611 lb., 1925, 3,387,875 lb.

Soda alum is chiefly used in textiles as a mordant, in the manufacture of paper, dry colors and in water treatment. The potash and ammonia alums are also used in textiles and paper, for the production of mordants, tawing and fire-proofing.

There is at present a duty of $\frac{1}{2}$c. per lb. As might be expected the importations of potash alum are heavy due to the European potash. As far as the other alums are concerned the American industry seems to be capable of taking care of itself.

On the Engineer's Book Shelf

American Potash Industry

POTASH, A REVIEW, ESTIMATE AND FORECAST. By *J. W. Turrentine*, in charge, potash investigations, Bureau of Soils, U. S. Department of Agriculture. John Wiley & Sons, Inc., New York. 188 pp. Price $3.

Reviewed by Frank K. Cameron

This book is a plea for continued interest in the development of an American potash industry; and logically Dr. Turrentine because of his official position and the extraordinary opportunities it affords, as well as because of his demonstrated abilities, is the man to write it. It should be read by everyone interested in the advancement of chemistry in this country, and the layman as well as the most sophisticated expert will find it of absorbing interest.

TEXAS AS A SOURCE OF POTASH

The general conclusions of the author seem to be that there is no real hope of cheaper potash from Europe, but rather an expectation of an increase in price to American consumers; that the threat of being cut off from foreign sources of supply may be lessened but by no means abolished by the changed political dominations of these foreign sources; and that an adequate domestic production not only can, but must be developed as the manufacturers of other commodities realize that it would be profitable to recover potassium salts as by-products. In addition there is a very real hope that buried but recoverable deposits of potash salts will be found in the panhandle of Texas. The author should have included also southern Utah, for which the existing evidence is just as good as for Texas. To all of this, everyone will agree, agreeing also that the author has given us a very "readable" presentation of the arguments and has not failed to include very much of the romance of the campaign which began before the War, acquired almost colossal proportions during that hectic period in American industry, and has continued since on a diminished but by no means vanishing scale. The publication is timely.

However, the text fairly bristles with invitations to criticism, in statements, in implications and in omissions. To the experts, this may well prove one of its most interesting and valuable characteristics, especially as seems probable, there will in due course of time be another edition, which will be accepted as an authoritative reference, not only to those interested in the history of this industry, but to those contemplating a participation in its future development.

In view of the possible development of deep seated layers of potash salts in Texas and in Utah, one misses a discussion of the cost and engineering features of the shafts sunk into the deposits in North Germany, Alsace or elsewhere. The very significant difference in the results of flooding should have been noted ruinous to a German shaft, but merely a distressing nuisance to an Alsatian one, as demonstrated by concrete instances in each case.

The uninformed reader would assume from the text that the Chappell process for the recovery of the values in alunite, as employed by the Armour Co. at Marysvale was the only successful development in that field. But in fact, there were quite respectable tonnages of alunite successfully treated with sulphuric acid (Cameron-Cullen process) at the Murray plant of the American Smelting and Refining Company and with lime (Morgan process) at Sigurd, the main importance of which is that a future development along the lines of either of these latter processes is more likely than along the lines of the Chappell process. However, as implied by the text, the prospect of any early development of significance is barred, by the fact that bauxite of South American origin and containing 63 per cent alumina can be delivered to existing reduction plants, cheaper than alunite containing 37 per cent or less of alumina. Similarly, the informed experts will hardly be satisfied by the text's statements of the reasons for the failure of the Sterling process and the implications as to future recovery of the values in Wyomingite. Actually a very satisfactory process, based on the well known Lemberg reaction of aqueous sodium chloride on leucite, yielding potassium chloride and analcite, was brought to pilot plant development by the Armours, but, unfortunately, had to be abandoned in the post war slump. Very reasonable calculations on the data obtained, indicated that "potash" from Wyomingite would be the cheapest in the world if sold at points of production in Wyoming; the long rail haul to consuming points and the expectation that foreign competitors could and would kill any large production by underselling has discouraged any capital from adventuring further in this field. Cheaper costs of operating as well as installation would make this process preferred, even were there no unsolved problems in the slagging of silica with lime in a rotary kiln.

UTILIZATION OF STEFFEN WASTE WATER

The suggestion in the text that the waste water from the Steffen operations be returned to the beet fields is quite impracticable. Very little of the acreage in beets is or ever will be immediately contiguous to the sugar mill, or so located that this waste water could be economically used for irrigating. Likewise are the suggestions for utilizing the sulphur dioxide in smelter stack gases, which is of a concentration (about 1½ per cent) prohibiting so far its successful employment in any useful way. The making of liquid sulphur dioxide as was done at the Tacoma smelter or the making of sulphuric acid as is done at several of the copper smelters, requires the operation of roasters or reverberatories in a special way to obtain a favorable concentration and generally at the expense of tonnage of metal produced and campaign of the roaster, the very factors on which the efficiency of the plant management is judged. It is unlikely, therefore, that there is to be any increased production of sulphuric acid at far

western smelters, except it be demanded by their own or closely associated operations as in the leaching of oxidized zinc or copper ores. The replacement of alkaline flotation methods for those employing acid methods is significant. It is misleading to quote the production of treble superphosphate by the Anaconda Copper Co., as this is the resultant of special considerations which are not operative generally. Incidentally, "treble super" is *not* made for local consumption, but because it can stand the freight required by the long rail haul to consuming points.

Likewise, the repeated suggestions in the text for the extended utilization of solar evaporation will be misleading to the uninformed, since there is no hint much less discussion of the difficult practical problems always encountered in any concrete case, nor of the general difficulties such as wind drift losses and seepages. It is far from true that the possible advantages of solar evaporation, so alluring "on paper" but so nearly universally futile in practice, have not had due consideration. Perhaps it is to have permanent place in western engineering practice, but there are many sceptics among those who have tried it.

Colloid Chemistry

COLLOID CHEMISTRY, VOL. I, THEORY AND METHODS. Compiled by *Jerome Alexander*. Chemical Catalog Company, Inc., New York. 976 pp. Price $14.50.

Reviewed by Brian Mead

Mr. Alexander's long-promised collection of papers on colloid chemistry by a large number of workers from all countries has received an excellent send-off in this first volume. Frankly, the quantity of material which is crammed into it is amazing, and one cannot be sufficiently grateful to the Editor for undertaking the drudgery attending such a compilation.

While it is true that some of the contributions are no more than re-hashed versions of material that was already in existence in re-hashed form, yet there are others in which new data are actually presented and so are valuable from that point of view. It is a matter of considerable satisfaction to those working in colloid chemistry in this country to have available in English such papers as that by Friedel on "The Mesomorphic States of Matter," and by Von Weimarn on "The Colloidal State of Matter," to mention only two of the important contributions by foreign chemists.

As far as the editorial duties are concerned, Mr. Alexander appears to have adopted the system of editing by footnotes. In some cases the comments so made are not particularly illuminating. The footnote on p. 118 seems to be misplaced. Similarly, the comment on Professor Millikan's paper on p. 191 might well have been either incorporated in the Editor's foreword or else in the article to which it refers. In the case of his comments on Miss Lloyd's paper, Mr. Alexander brings about an inversion of the normal state of affairs, for he, as Editor, takes rather unfair advantage of his position to have the last word on two controversial matters (pp. 767 and 773). One gets the impression on reading the book, of reading a marked examination paper, and it is almost with a feeling of surprise that one finds no grade at the head of the papers.

For the sake of continuity and standardization it is a pity that in some of the papers proper names are italicized, whereas this is not the case with others. The make-up of the book is attractive and it is pleasantly free of errors and misprints.

In the opinion of the reviewer this collection of papers should prove of immense value to the research worker and the teacher of colloid chemistry. It is unfortunate that the high price of the volume will debar it from use as a text for students who have bandied with *Bancroft*, battled with *Bogue*, hurried through *Holmes*, trifled with *Taylor*, sweated with *Svedberg*, zigzagged with *Zsigmondy*, been frightened by *Freundlich*, old-fashioned with *Ostwald-Fischer* and have allocated *Alexander's* little book its proper position.

Yearly Business Operations Since 1790

BUSINESS ANNALS—An attempt to summarize and depict the business conditions in 17 countries, including the United States, by years over an extended period in the country's history. By *Willard L. Thorp* and *Wesley C. Mitchell* of the National Bureau of Economic Research, Inc., New York. 380 pp. Price $4.

Reviewed by Robert M. Davis

No phase of business activities possesses more real interest to the executive and student of industrial operations than the study of the recurring "ups" and "downs" of business and industry, or what has come to commonly be known as the "business cycle." Its probable duration, and degree of prosperity and depression if they could be foretold would take much of the uncertainty out of business operations as they exist today. The comprehensive study of this subject, which has been made by Willard L. Thorp and just released by the National Bureau of Economic Research under the title "Business Annals" is therefore a most welcome contribution to the science of modern business.

"Business Annals" is an attempt to summarize and depict business conditions in 17 countries as they appeared to intelligent and expert observers. The tables and yearly business and economic analyses run back through a considerable period, those pertaining to the United States and England extending back yearly to 1790. Each year of this extended period is summarized as to economic conditions—industrial, commercial, labor, money, security, foreign exchange, agricultural production and prices—and is also reviewed as to various non-economic phenomena which may have exerted an influence upon the conditions of business.

This record of business conditions has been made especially valuable and attractive to the general reader by the inclusion of a chapter written by Wesley C. Mitchell explaining and interpreting the basic record in considerable detail. The cyclical character of business fluctuation and the duration of these business cycles is thoroughly discussed. Counting the business cycles as the intervals between recessions the author notes 32 business cycles in the United States in 127 years, which yields an average length of not quite 4 years. The commonest length is about 3 years and two-thirds of the cases fall within the limits of 3 to 4 years. There is no indication that the average duration of business cycles is changing. The interesting fact is brought out that American business cycles have a shorter average duration than those of any other country studied.

For those interested in the study of business and industrial trends, in the probable extent of the present period of prosperity, and the period of decreased industrial activity which must follow, this book will prove of large interest. It is a valuable contribution to the science of business and industrial administration.

For a Working Knowledge of Material Testing

LABORATORY MANUAL OF TESTING MATERIALS. By *William Kendrick Hatt*, professor of civil engineering, Purdue University, and *H. H. Schofield*, professor of civil engineering, Cornell University. McGraw-Hill Book Company, Inc., New York. 182 pp. Price $2.

The third edition of this manual, first issued in 1913 as the result of 18 years' operation of the laboratory for testing materials at Purdue University, brings the list of experiments up to date. Standard methods for testing iron, steel, wood, cement, concrete aggregates, reinforced concrete members, and road materials are included, ostensibly for college laboratory use, but providing the accepted instructions for the practitioner who occasionally finds it necessary to make tests of the various materials.

The Chemical Engineering Catalog

THE CHEMICAL ENGINEERING CATALOG. Eleventh Annual Edition. The Chemical Catalog Company, Inc., New York. 1190 pp. Price $10; leased, $2 per year in U. S. A.; $3.50 per year in Canada and Europe.

For eleven years "The Chemical Engineering Catalog" has served well its industry. There is little new comment to be made of the latest edition, except that it is a worthy and larger successor to previous members of this useful reference series.

The Story of Steel

THE STORY OF STEEL. By *J. Bernard Walker*, Editor emeritus of "The Scientific American." Harper & Brothers, New York. 208 pp. Price $4.

"The Story of Steel" is an interesting and accurate account of steel making, beginning with the ore and ending with the finished shapes. While the chemical or metallurgical engineer will find few if any new facts of technical interest, the excellent chapters on the marketing of steel, by Edmund Brown, Jr., should prove informative to most readers.

What Price Progress?

WHAT PRICE PROGRESS? By *Hugh Farrell*. G. P. Putnam's Sons, New York. 323 pp. Price $2.50.

This book, an outgrowth of serial articles appearing in the *New York Commercial*, is a newspaperman's version of science in industry. Here, research and chemical research in particular, is dramatized effectively. The most humble chemist, seemingly lost forever, should swell with pride and ask for a raise after reading one or two chapters, especially the ones entitled "Sugar, Milk and Alcohol" and "Phonographs, Photographs and Philanthropy." The book should prove useful in promoting the business man's interest in a serious investigation of the question "Does Research Pay?"

The Ethics of Business

THE ETHICS OF BUSINESS. By *Edgar L. Heermance*. Harper & Brothers, New York. 233 pp. Price $2.

Ethics as applied to business, is rapidly becoming of universal interest, at least in our well-seasoned industries. Ethics is to business what international amicability would mean to civilized peoples. The author has succeeded in demonstrating that ethics pays, and the proof is given in abundant illustrations from current practice. As the engineer is necessarily a big factor in molding human relations in industry, he could with much profit, read what Mr. Heermance has so ably written.

A COLLECTION OF CHEMICAL LECTURE EXPERIMENTS. By *H. P. Davison*, assistant professor of chemistry, Brown University. The Chemical Catalog Company, Inc., New York. 139 pp. Price $2.50.

The experiments described in this little book differ from the old familiar series that form a part of most books on laboratory technique. The arrangement of the book is new also, various important subdivisions being "Experiments with Gases," "Combustion and Oxidation," "Hydrolysis," "Colloidal Chemistry," "The Atmosphere," "Solubility and Solution," "Ammonia and Its Compounds," "Time Reactions," "Activity of the Elements" and "Miscellaneous."

ORGANIC CHEMISTRY FOR THE LABORATORY. By *W. A. Noyes*, director of the chemical laboratory, University of Illinois. The Chemical Publishing Co., Easton, Pa. 329 pp. Price $4.

This fifth edition of Professor Noyes' well-known book represents sufficient revision to keep pace with the recent advances in organic chemical technique. The book should appeal particularly to teachers that insist on periodical literature searches as an essential supplement to textbook study.

ORGANIC CHEMISTRY. By *William Albert Noyes*, director of the chemical laboratory of the University of Illinois. Henry Holt and Company, New York. 677 pp. Price $3.50.

In this textbook of organic chemistry for both beginners and advanced students, the theoretical principles of organic reactions are stressed. Sufficient illustrative data are included to give the student an interest in the fundamental relationships. As a result of this plan, the book is free from an overburden of descriptive matter, and should make an admirable college text for those intending to make chemistry a career.

Gas Directory and Catalog

BROWN'S DIRECTORY OF AMERICAN GAS COMPANIES AND GAS ENGINEERING AND APPLIANCE CATALOG. 1926 Edition. Robbins Publishing Co., Inc., New York. 831 pp. Price $10.

Annually, Brown's Directory presents the same complete information about gas companies and an increasing amount of catalog information of value to gas engineers. The 1926 edition, published recently, is no exception to the established rule for this work. It well deserves the place that most gas engineers have reserved for it on their book shelves.

Cable Corrosion

A new and rather serious problem of lead corrosion is being encountered in Pacific Coast regions. The trouble affects the lead covering of cables, resulting in the destruction of the sheathing and the formation of a white lead. This corrosion seems to be localized to land cables that are carried in creosoted wood conduits or ducts. The wood ducts are standard practice in both the eastern and western parts of the country, but pine is used in the East, fir being used in the West. The creosote used in the West differs also in that it has a higher tar acid content.

Readers' Views and Comments

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

Requirements for Success in Dyestuff Manufacture

To the Editor of Chem. & Met.:

Sir—On p. 523 of your issue for September, Doctor Derick lays down the necessary fundamentals for research in the dyestuff industry. I admit the great importance of the fundamentals listed:

(1) Physical constants for dyes and intermediates.
(2) Phase rule diagrams for materials employed.
(3) Complete analytical methods.

However, for the development of manufacturing technique, as the sole basis for building up a successful dyestuff industry, they would hardly prove sufficient.

Why does the synthetic dyestuff industry exist? Because it is a servant to the textile, leather and other industries. Therefore, the better it serves the textile industry, the greater its prosperity.

The research chemist in dyestuffs must develop *new* products which make production in a textile mill less costly or more rapid and which will improve the quality or appearance of the fabric. The staple dyestuffs are generally overproduced and highly competitive. As any moderate cost reduction due to some refinement in technique does not materially benefit the producer, the sales are not increased thereby.

Now, what fundamentals must the research chemist follow in order to increase the ability of the dyestuff industry to serve and to increase its economic importance?

(1) He must know the status of the art in scouring, spinning, weaving, dyeing, bleaching and finishing, the materials and dyestuffs now being used; their advantages and shortcomings. He must know the characteristics necessary in the dyestuff for its most advantageous use in the machine employed. For example, the chrome colors are sensitive to metals. This necessitates wooden equipment which is often a disadvantage.

(2) He must be familiar with current technical development in his own and related industries. The development of a new chemical compound or reaction often makes possible a radically new and cheaper synthesis for some well known dye or intermediate. A new style or technical development in the consuming industries often causes a change in the type of dyestuff required.

For example, the dyeing of the new cellulose acetate silk (celanese) requires entirely new dyestuffs. The new pyroxylin lacquer industry is creating a demand for solvent soluble colors—fast to light. The recent strong tendency for faster effects, especially on cotton, has largely contributed to the increased consumption of vat colors. The consumption in 1914 was 1,900,000 lb.; in 1924 3,300,000 lb. The almost simultaneous production of cheap phthalic anhydride and anhydrous aluminum chloride by new processes has made possible the new synthesis of anthraquinone at a lower cost and better quality than by the historical oxidation of anthracene.

(3) He must possess sufficient training, experience and strength of character to make his process a success in the factory. He must be able to work with men as well as with chemicals. Who has not heard of the brilliant laboratory achievement which has utterly failed in the plant?

Following these fundamentals, we should be able to develop our dyestuff industry, with its logical ramifications, in both branch and root. A vision of the potential requirements of the consumer is the road which may lead many of our struggling dyestuff plants to a place in the sun.

LINCOLN M. SHAFER,
Research Chemist,
Tower Manufacturing Co., Dyestuffs Division.
Newark, N. J.

Enriching Water Gas With Cracking-Still Residues

To the Editor of Chem. & Met.:

Sir—In your issue of September, 1926, on page 525, you have an article under the heading "Water-Gas Manufacturers Should Make Plans Now." The article is very much to the point; not only is the use of gas oil for cracking stock encroaching upon the material which the gas manufacturers require, but also the house-heating furnaces are using this type of oil, and the users of them are paying from 10 to 11c. per gallon.

There are at present approximately 2,900 different types of house-heating furnaces manufactured in the United States, and thousands of installations are being made each year. Each furnace will consume a minimum of 1,000 gal. per season, and while there are no statistics available as to the actual quantity of oil now used by the house-heating furnaces, yet the consumption is already a very large one.

These furnaces seldom are equipped to burn an oil lower than 28 deg. Bé., and 24 is about the lowest they can use and this oil is taken directly from the stocks available for gas oil.

The article draws the conclusion that water gas should be substituted by coal gas. To some extent this might be done, but on a large scale this would scarcely be practical. Complete gasification of coal is as yet not accomplished, excepting where coal gas is made and mixed with water gas produced in a regular water-gas set.

Without the addition of oil, however, this gas would be too low in B.t.u. to meet the present standards. As a matter of fact, if all the coke was to be used for making water gas, and only the coal gas was available to be mixed with it, the gas would be under 400 B.t.u. and it could be scarcely expected that the public service commissions would lower the B.t.u. standard that much.

There is, however, another way of approaching the subject. For the last 3 years I have experimented with cracking-still residues and have found it entirely feasible to make an oil gas from the same, which will enable the gas manufacturer to enrich water gas to any desired B.t.u. standard and do this without gas oil.

It is not very easy to produce this gas in conjunction with water gas, such as is done now in the carburetor attached to the water-gas generator. The gas

is produced in a separate apparatus and mixed cold with the water gas. In the following I will give you the analysis of a typical gas of this character:

CO_2	2.4
Illum.	49.7
O_2	0.6
CO	4.9
H_2	15.2
CH_4	21.7
N_2	5.7
Total,	100.2
Total Inerts,	8.7
Total B.t.u.,	1,402.5.

This gas is made from a cracking-still residue of approximately 10 deg. Bé. It is produced without the deposition of carbon in the apparatus and without the production of undesirable emulsions, as is often the case when heavy oils are used for gas enrichment.

COMMERCIAL SUCCESS DEMONSTRATED

As is well known, cracking-still residues carry quite a proportion of suspended carbon and are very undesirable for fuel oil and should therefore become readily available for the manufacture of enriched water gas. Only a few hundred feet of this type of gas are required to enrich 1,000 cu.ft. of water gas. This gas is now being produced with an initial installation of a capacity of 25,000 cu.ft. per day and the plant has been in operation for several months with excellent success.

Needless to say, the cost is considerably less than water-gas enrichment by the use of gas oil. Exact data are available for private use but not for publication.

It must be considered that the installation of coal distillation plants of the present type, substituting the present water-gas capacity of the United States, would run into hundreds of millions of dollars, and the coke production would be altogether out of proportion with the markets. It seems therefore that the above-described method is timely and will solve this question for some time to come, particularly since the cost of installation is nominal.

ALFRED SCHWARZ,
Consulting Engineer.
25 Broad Street,
New York, N. Y.

Typographical Pitfalls

To the Editor of Chem. & Met.:

Sir—Several typographical errors crept into my recent article, "Solving Some Unusual Problems in Sand Filtration" (*Chem. & Met.*, 33, 529-533, September, 1926): At the top of page 532 appears the statement "c is the value of y when $x = l$." This should read "when $x = 1$." The same error was made in two equations appearing at about the middle of the second column on page 532. In both instances the letter l was used instead of the figure 1.

On page 533, Hazen's effective diameter of a sand is defined as "the screen opening which will retain 10 per cent by weight and allow 90 per cent to pass." This should read "retain 90 per cent by weight and allow 10 per cent to pass." This was an error in the manuscript, for which I offer my apologies.

In the table of "Properties of Various Sands Used for Filtration," on page 533, figures are quoted for the "Altoona" filter. This should read "Altona," referring to a city near Hamburg in Germany.

MARION E. DICE.
General Petroleum Corp.,
Los Angeles, California.

For Intelligent Enforcement of the Law

To the Editor of Chem. & Met.:

Sir—In your issue of August, 1926, I am interested to see your explanation of the unfortunate editorial of July, entitled "Attention Mr. Wayne B. Wheeler." In my opinion this explanation does not help matters very much, for the reason that your apparent willingness to treat flippantly one of the most serious undertakings of the age, is only a little less objectionable to many of your readers, than open antagonism would be.

I am aware of your statements that your only interest in the matter is the protection of legitimate users of industrial alcohol. Judging others by myself, I feel sure that the tone of your articles has prevented people from accepting these protestations as sincere. Your "explanation," noted above, may serve as an illustration of the discrepancy between tone and statement to which I refer.

Surely a reputation for sincerity is one which you can ill afford to lose.

You need feel under no obligation to acknowledge the receipt of this, nor to publish it, unless you so desire.

Sincerely, one of your many grieved subscribers.

Philadelphia, Pa. JNO. D. CARTER.

We are glad that you took occasion to express your disapproval of our "flippant" treatment of prohibition. We can only reply that there is no such intention on our part, and that our comments on prohibition and industrial alcohol bear no relation to our personal preferences and habits. *Chem. & Met.* has no "policy" on prohibition. The Volstead Act is the law of the land and we believe in law enforcement. At the same time we protest against unintelligent enforcement which handicaps a great industry which plays a daily part in your life and mine.

Years of experience in editorial work has long since shown us that subscribers to publications of all kinds read their own thoughts into editorial utterances. It is for this reason that in the same mail we receive both commendation and disapproval of purposes attributed to us but in fact supplied by the reader. Some of our subscribers approve our "stand against prohibition," when we have none. Others, like yourself, object to our "antagonism" which does not exist. It is too much to hope for universal approval from our readers, but we can always ask that they believe us to be sincere.—EDITOR.

Industrial Research Laboratories in the United States

To the Editor of Chem. & Met.:

Sir—The continuing demand for a new edition of Bulletin No. 16 of the National Research Council which contains a list of research laboratories in industrial establishments of the United States indicates that this list apparently fills a certain need in the industrial world, and confronts us with the fact that the material assembled in 1921 is five years out of date.

In order that the new list may be as complete as possible we are appealing to the readers of this journal who are connected with firms now maintaining research laboratories to send us the name and address of the firms with which they are connected. Questionnaires will then be sent to these firms.

C. J. WEST.
Director,
Research Information Service.
National Research Council,
Washington, D. C.

Selections From Recent Literature

Lubricating Oil. A. E. Dunstan and R. W. L. Clarke, *J. Soc. Chem. Ind.*, Sept. 24, pp. 690-4. Manufacture of oils having the desired physical and chemical properties; theory of lubrication; effect of blending miscible and immiscible lubricant combinations.

Deodorizing Oils. W. Brash, *J. Soc. Chem. Ind.*, Sept. 24, pp. 331-3T. In steam deodorization on the counter-current principle, the height of the tower depends on temperature, thickness of oil layers and rates of efflux of the oil and steam. The conditions for steady flow and for economy in steam utilization are derived from theoretical considerations.

Grinding. J. W. Hinchley, *J. Soc. Chem. Ind.*, Sept. 24, pp. 341-2T. Machines for very fine dry grinding, e.g., of paint pigments, and other solids.

Sifting Plant. Alexander Ogilvie, *J. Soc. Chem. Ind.*, Oct. 1, pp. 713-8; Oct. 8, pp. 735-7. Illustrated description of equipment for screening, including inclined and vibrating screens; and for air separation.

Adhesives. Leit, *Kunststst.*, Oct., pp. 189-91. A review of German patents of recent years on casein, albumin and animal glues; rubber and cellulose ester cements; cellulose wastes, beet cuttings and adhesives from other sources.

Electrodeposition of Metals. Naville, *Bull. Soc. Chim. Ind.*, July-Aug.-Sept., pp. 38-9. Electrolytic refining is becoming nearly as important in zinc metallurgy as in copper. Electrolytic iron is not yet commercially successful on any large tonnage scale; but its special properties may be a sufficient incentive for further development along that line. The beneficial influence of a small amount of a salt of another metal in the electrolytic bath should be investigated in the case of iron.

Vinasse Distillation. Guillissen, *Bull. Soc. Chim. Ind.*, July-Aug.-Sept., p. 41, Application of the low temperature distillation principle to the pyrolysis of beet vinasse greatly improved the yield of valuable products. About 80 to 95 per cent of the N can be recovered in the form of ammonia or simple amines readily converted to nitriles. Ketones are also obtained, chiefly acetone, methylpropyl ketone and diethyl ketone. The tar does not contain N.

Barium Hydrate. De Guide, *Bull. Soc. Chim. Ind.*, July-Aug.-Sept., p. 46. An improved process of making $Ba(OH)_2$. The carbonate is converted to the bisilicate; on treatment with water this gives the monosilicate and the hydrate. If cheap enough, barium hydrate would have some advantages over lime in the refining of beet and cane sugar, in making caustic soda, and in other processes.

Algin Plastics. Maurice Deschiens, *Revue gen. mat. Plastiques*, Sept., pp. 557-63. Sodium alginate reacts with salts of alkaline earths or heavy metals, forming insoluble alginates which are useful as plastics (artificial horn). Large quantities can be had from the seaweed harvests.

Mills for Plastics. M. Loret, *Revue gen. mat. Plastiques*, Sept., pp. 576-8. Illustrated description of laboratory mixers and of mixers and two roll mills for factory use in working plastic materials.

Sodium Perborate. Umberto Sborgi and David Lenzi, *Giorn. chim. ind. appl.*, Aug., pp. 423-7. A process has been worked out on a commercial scale at Larderello for electrolytic production of sodium perborate. The product is 99-100 per cent pure, with a 40 per cent current efficiency. The preferred type of cell is described and illustrated, and details of the process are given.

Aldehyde Condensation Products. Henri Barthelemy, *Chim. et Ind.*, Sept., pp. 367-72. Among the aldehyde condensation products with phenols, urea, etc., "Prystal" is the first which has no color itself and is not reddened by sunlight. It is a formaldehyde-urea resin. It is not as transparent to ultraviolet light as Pollopas, but it has a very low density and has some other advantages.

Paper Fillers. J. Stewart Remington, *Ind. Chemist*, Oct., pp. 430-2. Properties and use of satin white, agilite, gypsum, abionite, barytes and like pigments in paper making.

Flue Gas Control. Julius Grant, *Ind. Chemist*, Oct., pp. 433-6. Illustrated account of the construction and use of carbon dioxide recorders and gas analysis outfits in the control of combustion.

Sodium Peroxide. *Ind. Chemist*, Oct., pp. 441-4. Among the products derived from salt, sodium peroxide is important. The layout of a peroxide plant is illustrated, and its operation is described.

Engineering Wastes. J. B. C. Kershaw, *Ind. Chemist*, Oct., pp. 449-53. Electromagnetic separators and other equipment for treatment of waste and salvage of valuable material in machine shops and other engineering establishments. Illustrated.

Sulphur Dyes. J. H. Platt, *Ind. Chemist*, Oct., pp. 458-61. Modern practice in the manufacture of sulphur yellows, browns, blues and blacks. A brief sketch of the history of sulphur dyes is given.

Electro-osmosis. Kurt Illig, *Zeitschr. angew. Chem.*, Sept. 16, pp. 1085-93. A review of the technical of electro-osmotic processes. One of the principal uses is in the treatment of industrial and potable waters. Illustrated.

Bergius Process. A. Spilker and K. Zerbe, *Zeitschr, angew. Chem.*, Sept. 30, pp. 1138-43. The chemical processes involved in the Bergius treatment are discussed. Reaction will not occur below a certain limiting temperature, which depends on the pressure and other factors. The principal reactions are hydrogenation of aromatic compounds, breaking down of aromatic rings and hydrogenation (more or less complete) of the resulting open chain compounds.

Non-ferrous Metals. A Petersen, *Zeitschr. angew. Chem.*, Oct. 7, pp. 1170-1. A review of progress in the industrial utilization of the light metals. In addition to Al and Mg, Li is being found very useful for increasing the strength of other metals. Al and its alloys are particularly useful in the automotive field.

Sugar from Wood. F. Bergius, *Zeitschr, angew. Chem.*, Oct. 7, pp. 1202-3. The acid hydrolysis of wood on a large scale, to produce sugar for stock feeding, is commercially feasible. The future of the process depends not on the crowding out of older agricultural products, but on extending the geographical limitations of feed production. An acre of forest land will grow as much carbohydrate in a year as an acre planted to cereal crops.

Ferric Chloride. F. Chemnitius, *Chem.-Ztg.*, Sept. 22, pp. 710-1. Illustrated description of a plant for dissolving Fe in HCl, chlorinating the liquor, and recovering hydrated crystals of $FeCl_3$ from the solution. Wood vats and stoneware vessels are used.

Improved Crystallization. C. Stiepel, *Chem.-Ztg.*, Oct. 2, pp. 745-6. Making fine soda crystals, by crystallization in motion, in a plant which, by proper circulation, brings small amounts of solution in contact with a large area of cooling surface. The process is continuous. Illustrated.

Satin White. P. Fuchs, *Chem.-Ztg.*, Oct. 13, p. 769-70. Satin white, which is valuable as a pigment, is by definition: A mixture of gypsum and Ca aluminate in the mol ratio 5: 2, with small variable amounts of hydrated lime. Impurities and hydrolysis products (if any) of Ca aluminate are disregarded in this definition.

Magnesite. Alfred Stettbacher, *Chem.-Ztg.*, Oct. 13, pp. 771-4. The process of burning magnesite to form active magnesia. Uses of magnesia are discussed. Magnesite shows the same chemical reactions as lime, but is slower.

Discharging Liquids. Fritz E. Dollfus, *Chem.-Ztg.*, Oct. 13, pp. 775-6. New siphon designs, some in soft or hard rubber, some in glass, etc., for emptying carboys, kegs, vats, tanks, etc. Illustrated.

Refrigeration. E. W. Lewis. *J. Soc. Chem. Ind.*, Oct. 22, pp. 771-7. Thermal principles of refrigeration; illustrated description of plant for use of NH_3, of CO_2, etc.

Anti-Oxidants. *Rubber Age* (N. Y.), Oct. 10, pp. 27-8. The age resistors which have been developed for preserving rubber goods are also finding other uses. An important example is in retarding the deterioration, by oxidation of insulating oils used for saturating paper cable wrappings.

Artificial Filaments. P. P. Von Weimarn, *Can. Chem. & Met.*, Oct., pp. 227-8. By a new process, certain plastics can be made into filaments from dispersion in aqueous thiocyanate solutions. Threads have been made in this way from casein, chitin, keratin and silk fibroin. The process is protected by a patent application in Japan.

Cellulose Fermentation. H. B. Speakman, *Can. Chem. & Met.*, Oct. pp. 229-31. A method is outlined for cheap production of organic solvents by fermentation of the various sugars present in sulphite liquor. Other cellulose products and derivatives could also be utilized if the process is commer-

cially successful. Acetone would be a principal product.

French Oil Shales. Camille Chabrie, *Ind. Chemist*, Sept., pp. 391-2. Illustrated account of the production of oil from the shale deposits at Telots. Steam distillation of the crude oil is practiced. The average yield per cu.m. of shale is about 75 liters of oil, 5 liters of gasoline and 10 to 12 kg. of ammonium sulphate.

Essential Oils. *Ind. Chemist*, Sept., pp. 393-9. Collecting flowers; extraction by the processes of enfleurage, maceration, steam distillation and solvent extraction. The methods are compared, and choice of solvents in the extraction process is discussed. The fats from enfleurage are not used twice; they are sold to soap makers. Illustrated.

Pigments. Chas. H. Butcher, *Ind. Chemist*, Sept., pp. 400-1. An illustrated photomicrographic study of various white pigments, including white lead, zinc white, silex, lithopone, titanium white, whiting, asbestine and others.

Caustic Recovery. H. Sunder, *Chim. et Ind.*, Sept., pp. 520-5. In the purification of spent caustic from mercerization processes, application of the centrifuge, or the super-centrifuge when needed, may be expected in future practice as an improvement over present refining methods. A new method, without centrifuging, is described which is superior to the best prevailing practice. It utilizes rosin soap as a clarifying agent.

Nitric Acid. M, Kaltenbach, *Chim. et Ind.*, Sept., pp. 479-83. Thermal and other principles involved in the concentration of commercial nitric acid; description and drawings of a plant for concentrating the nitric acid and recovering the sulphuric acid.

Graphite. L. de Pritzbuer, *Chim. et Ind.*, Sept., pp. 473-8. Refining graphite by grinding and flotation; by electro-osmosis, and by chemical processes; equipment used; properties and uses of refined graphite. Illustrated.

Coke Substitute. Robt. D. Lance, *Chim. et Ind.*, Sept., pp. 399-405. By blowing a suitable fuel gas into the blast furnace, at least 30 per cent of the metallurgical coke can be saved, and the cost per furnace charge can be considerably lessened. It is even possible to use a cheaper fuel than coke in this process, e. g. a high-ash coal, thus making a still greater saving.

Corrosion. Corrosion problems in the manufacture of ammonium sulphate at gas works and coke ovens are discussed. The parts of equipment involved are the centrifugal and the steam-air injector (lifter). Experiments have demonstrated that Monel metal is far superior to other materials of construction. Tests on the corrosive action of sulphuric acid on sheet lead are also reported. P. Parrish, *Chem. and Ind.*, vol. 45, pp. 612-20.

Smokeless Fuel. Conference on solid smokeless fuel at joint meeting of the Fuel Section of the Society of Chemical Industry with the Coke Oven Managers' Association and the Institution of Gas Engineers, at the Congress of Chemists, July 23, 1926. Summary of papers and discussions on "Solid Smokeless Fuel" during 1925. Compiled by E. W. Smith, *Chem. & Ind.*, vol. 45, pp. 289-301 T.

Coking in Coals. The coking propensities of coal—a discussion. W. A. Bone, *Chem. & Ind.*, vol. 45, pp. 646-7.

Sugar. A detailed description of the various unit operations involved in the manufacture of beet sugar. J. Kwantes, *Chem. & Ind.*, vol. 45, pp. 638-45.

Evaporation. Evaporators for salts with inverted solubility curves. W. L. Badger and H. B. Caldwell, *Canad. Chem. & Met.*, vol. 10, pp. 208-11.

Heat Economy. Heat economy in the cellulose industry. (Cont.) Anon., *Chem. Apparatur*, vol. 13, pp. 179-81.

Filtration. Experiences on filtration of solutions in the potash industry. Th. Hoffmann, *Chem. Apparatur*, vol. 13, pp. 189-20; 209-12.

Rayon. Description of equipment used in the conversion of xanthate into viscose and for filtration (Cont.). E. Wurtz, *Chem. Apparatur.*, vol. 13, pp. 185-8; 200-1.

Filtration. Operating data on the stream line filter involving city water, clay suspensions and oil from the crank case of Diesel engines. J. W. Hinchley, *Chem. & Ind.*, vol. 45, pp. 660-4.

Crystallization. The separation of potassium nitrate and the recovery of other salts from crude Indian saltpetre. M. A. Hamid, *Chem. & Ind.*, 1926, vol. 45, pp. 315-20.

Sulphur. The possibility of obtaining pure sulphur directly from sulphur containing gases by treatment with solutions of copper salts is discussed and experimental data presented F. Fischer and P. Dilthey, *Brennstoff-Chemie*, vol. 7, p. 300.

Cooling. Cooling of large quantities of liquid by evaporation under vacuum. K. Thormann, *Chem. Apparatur*, vol. 14, pp. 201-2.

Filtration. Description of plant for rapid filtration of large quantities of water. E. Gundermann, *Chem. Apparatur*, vol. 13, p. 203.

Government Publications

Prices indicated are charged by the Superintendent of Documents, Washington, D. C., for pamphlets. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from Bureau responsible for issue.

Use of Glue in Coated Paper, by G. K. Hamill, V. H. Gottschalk, and G. W. Bicking. Bureau of Standards, Technologic Paper 323. 15 cents.

A Study of Sieve Specifications, by L. V. Judson. Bureau of Standards, Technologic Paper 321. 5 cents.

Effect of Dry Cleaning on Silks, by M. H. Goldman, C. C. Hubbard, and Charles W. Schoffstall. Bureau of Standards, Technologic Paper 322. 15 cents.

Analysis of Dental Gold Alloys, by William H. Swanger. Bureau of Standards, Scientific Paper 532. 10 cents.

Properties and Manufacture of Concrete Building Units. Bureau of Standards, Circular 304. 20 cents.

Safety Rules for the Operation of Electrical Equipment and Lines. Bureau of Standards, Handbook No. 8. 15 cents.

Package Sizes for Insecticides and Fungicides. Department of Commerce; Simplified Practice Recommendation 41. 5 cents.

Magnetic Concentration of Flue Dust of the Birmingham District, by Oscar Lee, B. W. Grandrud, and F. D. DeVaney. Bureau of Mines, Serial 2761.

Gas-Making and Fuel Problems of the Gas Industry of California, by Wm. W. Odell. Bureau of Mines, Serial 2769.

Fluctuations in the Temperature of Natural Gas Flowing in Buried and in Uncovered Pipe Lines, by E. L. Rawlins. Bureau of Mines, Serial 2771.

Fatalities in the California Petroleum Industry During the Calendar Year 1925, by H. C. Miller. Bureau of Mines, Serial 2772.

Hydrogen Sulphide Poisoning in the Texas Panhandle, Big Lake, Texas, and McCamey, Texas, Oilfields, by W. P. Yant and H. C. Fowler. Bureau of Mines, Serial 2776.

Procedure for Testing Explosives Used in Metal Mines, Tunnels, Quarries, and Other Engineering Operations, with Test Requirements and Schedule of Fees. Bureau of Mines, Schedule 1 B.

Mineral Statistics for 1925—preliminary estimates in mimeographed form from Bureau of Mines on: Coke and By-Products; Portland Cement; Clay; Masonry, Natural, and Puzzolan Cements; Petroleum.

Production Statistics from 1925 Census of Manufactures in preliminary mimeographed form for: Explosives; Rubber Tires and Inner Tubes; Linoleum, Asphalted-Felt-Base Floor Coverings, and Oilcloth; artificial Leather; Rubber Goods, Other Than Tires and Tubes and Boots and Shoes.

Cocoa By-Products and Their Utilization as Fertilizer Materials, by G. P. Walton and R. F. Gardiner. Department of Agriculture, Department Bulletin No. 1413. 10 cents.

United States Trade with the British Empire in Hides, Skins, and Leather, by J. Schnitzer. Bureau of Foreign and Domestic Commerce, Trade Information Bulletin 422. 10 cents.

A Health Study of Ten Thousand Industrial Workers—Statistical Analysis of Surveys in Ten Industries. U. S. Public Health Service, Bulletin 162.

Commercial and Industrial Organizations of the United States, Revised to June 1, 1926. Bureau of Foreign and Domestic Commerce, Domestic Commerce Series No. 5. 60 cents.

Miscellaneous Publications

Guide to Current Official (British) Statistics. Issued annually. A survey of all statistics published by the British Government, containing an alphabetical index which indicates the nature and mode of analysis of the statistics listed and the time and place to which they relate. The Guide and the official publications listed in it can be purchased from the sales offices of His Majesty's Stationery Office, Adastral House, Kingsway, W. C. 2, London, England. 1 shilling 3½ pence post free.

The Plant Notebook

An Exchange for Operating Men

Continuous Sampler for Hygroscopic Material

By Paul Stegeman
Midland, Michigan

Plants using a large volume of material in a continuous process where chemical control is necessary are faced with the difficult problem of procuring accurate samples. When, in addition, the material is hygroscopic the difficulties encountered are multiplied several fold.

To overcome these difficulties we devised the sampler shown in the accompanying sketch, Fig. 1. The material being sampled was granular and, being screened, was comparatively free from dust and oversize, although trouble from these sources was guarded against in the design of the sampler. Material was discharged from the screen into a short vertical section of spout and thence down an inclined spout to the elevator boot, as shown in Fig. 1. A large volume of material was handled and the velocity in the spout was high enough so that plugging of the spout did not occur as long as the elevator was in operation.

As the material was extremely hygroscopic, the samples could not be freely exposed to the air, so the sampler had to be designed to protect the sample until the operator collected it.

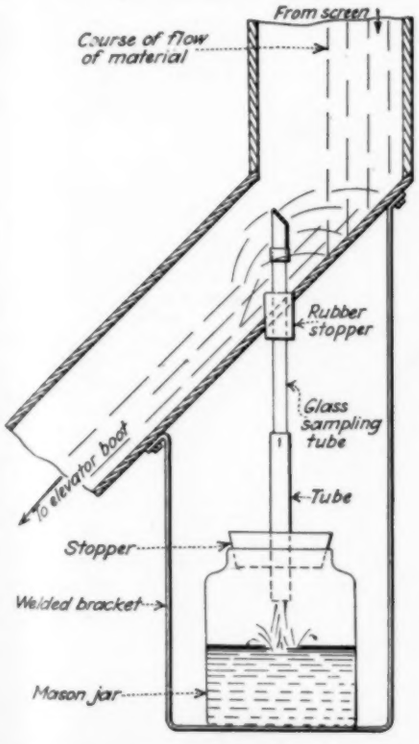


Fig. 1—Sketch of Sampler for Obtaining Samples from Continuous Flow of Hygroscopic Material

The sampler was installed at a point where advantage could be taken of the velocity of discharge from the screen. As the material, dropping from the screen, struck the bottom of the vertical spout and then moved off at an angle, some of the granules rebounded before going down the inclined spout and it was here that our sampler was inserted. A hole was burned in the bottom of the inclined spout, about 3 in. from the edge of the vertical spout. Into this a rubber stopper was fitted and a ¼ in. glass tube inserted with a tip designed as shown in Fig. 2. This tube was connected with a quart Mason jar by means of a rubber tube. The jar was placed directly beneath the inlet so that no plugging could occur at that end and the tip of the tube was guarded against plugging by a spring wire, as shown in Fig. 2.

The amount of material collected in the jar during a given time was easily regulated by sliding the glass tube up or down so as to catch more or less of the granules. The intake of the sampler was not exposed to the full flow of the material but took its sample from that small portion of the granules that rebounded from the bottom of the spout.

Since the container was of glass, the sample was at all times visible so that adjustments in the rate of collection were easily made to suit the rate of flow of material. The operator who collected the sample carried with him an empty jar to replace that containing the sample, so that the only time the sample was exposed to the air before reaching the laboratory was during the change of containers.

To date this sampler has been found to be the most satisfactory method of obtaining the samples of many tried, so far as continuous operation, freedom from plugging and visibility of operation are concerned. By shaking the jar the analyst can get a very good representative sample of a period's run with much greater accuracy than a random sample would give. The whole apparatus can be easily removed in case repair work is necessary on the spout or when the equipment is to be cleaned.

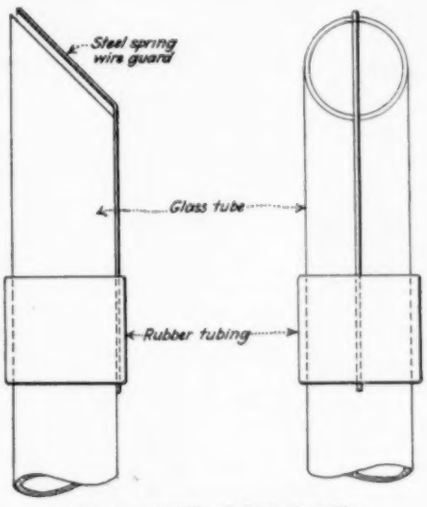


Fig. 2—Detail of Sampler Tip

Help of a Chemist Needed

By Philip De Wolf
Providence, R. I.

In looking over some notebooks I have come across some material dealing with wastes caused by carelessness which may be of some interest.

One of the largest cotton finishers in the country became interested last summer in a new method of preparing bleach liquors, and as a natural preliminary made a thorough investigation of the liquors they were making up by their old process. Up to that time all "analyzing" has been done with a hydrometer, although the plant had a rather unusual chemical department including a research laboratory. The standard liquor contained 28 grams of chlorine per liter. But a six months' investigation showed a range from 16 to 26 grams per liter. It seemed that just as good results were obtained with the 16 as with the 26 mixture. The investigation showed great carelessness in makeup and testing, that at 26 grams per liter a lot of bleach was used unnecessarily, that at 16 grams per liter there must have been some very poor bleaching powder used and it must have been used very carelessly, and that at 26 grams per liter there was a considerable overbleaching and consequent tendering of the goods. All this has resulted in much more checking of solutions throughout the plant and the uncovering of small wastes, the elimination of which both saves material and insures better work.

At a paper mill where a special grade of paper was produced, an investigation of the bleaching procedure showed large variations in the strength of the bleach liquor with occasional lots of paper being rejected as not up to strength. In this mill the liquor has been titrated for some years but nothing was ever done with the figures. However, they were available and a back check showed a surprising agreement between rejected lots and over-strong liquors. This mill is using about one-third of the available chlorine either as bleaching powder or liquid chlorine now compared to what it was using before the study was made and this figure is from the purchasing department, not from the operating department. Rejections of paper as below strength has practically stopped.

At another mill a two months' study showed variations from 4.75 to 17 grams per liter. The superintendent,

a "practical" paper man said, "Well, Charley (the chemist) must have made a mistake." But it came out that Stanley, who had lived in this country 25 years and could not speak intelligible English yet, was putting water in the make-up tank to "up near" the top and was using sometimes one and sometimes two 800-lb. drums of bleaching powder. And Charley says the conditions in the rosin size make-up are still worse.

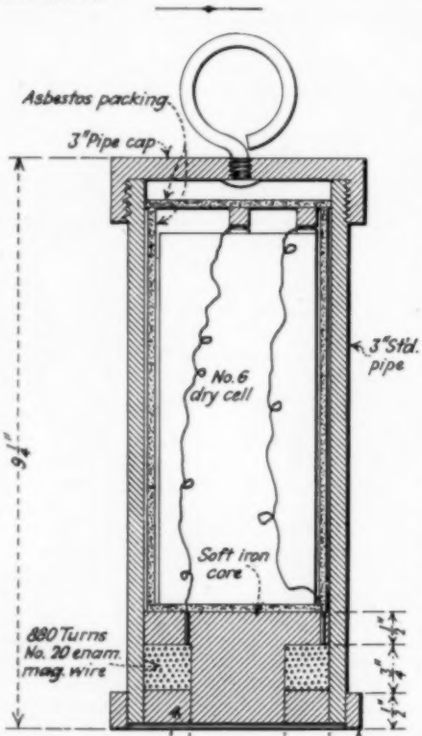
Suiting the Power Supply to Plant Conditions

In the Mohave Desert of California, the American Trona Co. has a plant which produces borax and other chemicals from the salt of a dry lake. This plant, which is at an altitude of 1,675 ft., is faced by a number of natural obstacles from the standpoint of power mostly due to the extreme dryness of the atmosphere, which has a relative humidity of 20 per cent, and the shortage of water which can only be obtained at great expense.

In general, the process used by this plant consists of making a brine of the salt from the lake and then evaporating this. Large quantities of steam are used in triple-effect evaporators for this purpose.

Electric power for the plant is purchased. Some power, however, is generated in a specially-designed General Electric turbine generator and by this means considerable economies are effected. Steam is generated at a boiler pressure of approximately 160-lb. gage and delivered to the turbine at a pressure of 150 lb. without superheat. Normally the turbine generator unit operates as a reducing valve between the steam supply and the process steam line. The drop in pressure between the boiler pressure and the pressure of the process is made in the turbine and thus some of the electric power needed is generated. This turbine is designed to have its best economy at 28 lb. gage back pressure during normal operation, the exhaust steam being sent at this pressure into a common header which also receives exhaust steam from steam-driven pumps and other equipment, and which supplies steam to the evaporators. The turbine exhaust is maintained at 28 lb. gage by means of a back pressure regulator controlling the turbine through the medium of the governor synchronizing equipment in accordance with the fluctuations in demand.

This turbine is also arranged for condenser operation in case of failure of the outside power supply. The public utilities system being largely hydro-electric, sudden loss of system load would tend to cause dangerous overspeeding of the American Trona Co.'s equipment because their generator is in synchronism with the hydro-electric generators. This is prevented, however, by an emergency governor tripping mechanism with an emergency cut-out switch which will throw the generator off the incoming power line before dangerous overspeed develops. While the turbine is designed for normal operation at 28 lb. back pressure, it will also operate at high economy when operated condensing. This fact is very important for this location. Mountain spring water is used in the air cooler which cools the generator and this water, after passing through the cooler is sent to the boiler feed water heaters and hence into the boilers. Thus the generator losses absorbed by the cooling air in the form of heat are largely conserved.



Sketch of Device Used for Removing Small Steel Objects from Tanks and Other Inaccessible Places

Recovering Steel Objects from Inaccessible Places

The device illustrated in the accompanying sketch has been found very useful for recovering small objects, particularly plumb bobs and broken ends of measuring tapes, from tanks and inaccessible places.

The apparatus consists of an electromagnet energized by an ordinary dry cell. No external wires are required, as it operates on a closed circuit. The cell is connected to the terminals of the coil, the cap is screwed on, and the apparatus is lowered into the tank with a rope. The life of a dry cell in continuous service with such a coil is about twenty hours, so there is little danger of burning out a cell every time it is used.

The coil has 880 turns of No. 20 enameled magnet wire wound on a soft iron core. To prevent the core from resting directly on a steel plate such as a tank bottom, a brass collar is provided on the lower end of the 3-in. pipe housing.

The device will lift objects weighing up to one pound. For heavier objects, the pipe should be made longer and more cells provided in proportion to the weight to be handled.

Economy of Closed Circuit Grinding

In a recent issue of *Engineering & Mining Journal*, H. W. Shoemaker gives some interesting information on the advantages of closed circuit grinding and classification in the successive steps of a grinding installation.

The original unit in this installation consisted of a 7x6 ft. ball granulator delivering to a 24 ft. by 4 ft. 6 in. by 15 ft. diameter duplex Dorr bowl classifier of the type known at type "C". This classifier was in a closed circuit with a 5x16 ft. tube mill using 1¼ in. steel balls. Feed to this unit was the product of 54x24-in. rolls delivered to the bins without screening at approximately minus 1 in. The finished product was approximately 90 per cent through 200 mesh at the bowl overflow. Under these conditions and with the classifier making 13 strokes per minute, the maximum tonnage in 24 hours was 175 tons. Forcing tonnage beyond this point usually resulted in mechanical trouble with the mechanism of the classifier. This trouble was partially remedied by speeding the rakes up to 20 strokes per minute, thus giving increased raking capacity but decreasing the load per stroke. This improvement together with reinforcement of the head motion enabled the unit to handle 190 to 200 tons per 24 hours.

It was determined to replace the light type "C" classifiers with the heavy duty type "D" of the same dimensions, except for the width, which was 6 ft. By this change it was hoped to get away from the occasional breakage of the lighter model and by providing a heavier circulating load for the tube mills, to increase its efficiency. With this change the production was increased to 225 tons per 24 hours.

Throughout the successive changes the ball granulator was running below capacity because of the necessity of favoring the classifier and tube mill. The limiting factor seemed to be the small percentage of oversize delivered by the ball mill which accumulated in the tube and classifier circuit to a prohibitive degree. To meet this excess of capacity of the ball mill over the tube mill and to make use of the discarded type "C" classifiers, the bowls were removed from these classifiers and the raking compartments cut down to 18 ft. and put in closed circuit with the ball mills. They were deeply pitched—3½ inches to the foot—and the rake speeded up to 27 strokes per minute. The discharge of the ball mill had originally been provided with a cylindrical screen of ½-in. mesh. This was replaced with one of 1-in. mesh. The mill is loaded until oversize passes this screen in a total not exceeding 500 pounds per day.

The moisture on this primary classifier is kept quite low, only the coarser material being raked back and returned to the ball mill. The whole arrangement, however, is very flexible and practically any desired size of product is possible. The practical effect is the elimination of the oversize heretofore sent to the fine grinding circuit, a finer average material for the tube mill to handle and a better balancing of the capacity of ball and tube mills.

Equipment News

From Maker and User

New Gas Engineering Equipment

American Gas Association Exhibit and Convention Proceedings Include New Equipment of Chemical Engineering Interest

Editorial Staff Report

THE EIGHTH Annual Convention and Exhibition of the American Gas Association were a clear demonstration, first, that the manufacture of gas is a chemical engineering process, and second, that gas engineers generally are beginning to realize this fact. Not only are they borrowing from other industries equipment and apparatus for unit operations within their plants; they are also developing new equipment of this sort which can profitably be utilized throughout a great many other industries.

New Vertical Ovens

Coal-carbonizing equipment firms offered two new types of apparatus for the first time this year, both new vertical ovens systems. The U. G. I. Contracting Company is now offering for American erection an adaptation of the German Stettiner Company's vertical oven shown in Fig. 1. This is an intermittent type intended particularly for small and intermediate size plants, making from 150,000 cu.ft. per day up. It is claimed that the new type of oven will be of reasonable installation cost, easily operated, involving low labor cost, and giving a yield and efficiency comparable with the standard types of horizontal coke oven.

A normal installation will probably be of three to six ovens per bench with a single built-in producer to supply heating gas. Each oven will be approximately 11½ in. by 10 ft., in horizontal cross section and with a coal space 20 ft. high. The charge will be about 6 tons per oven and will be carbonized in about twelve hours. Provision is made for steaming of the ovens, not only to increase capacity but also to increase ammonia and other by-product yields. The promoters believe that the European experience with this type of oven has proven its efficiency and that excellent temperature control is assured. The simpler construction, as compared with vertical retorts, insures fewer refractory special shapes and hence lower erection cost. The ground space required is comparable with that of a vertical retort installation, and hence less than that required for a horizontal oven of the same capacity. The coke produced in this type of oven resembles that made in the vertical retort, but the average size of piece is somewhat greater.

The second type of vertical oven most widely discussed about the exhibits was the new vertical oven installation which has been developed at the Seaboard plant of the Koppers Co. This is a continuous vertical unit designed to carbonize about 10 tons of coal per oven per day. A new plant consisting of five of these ovens is now being designed for the Illinois Northern Utilities Co., to be erected at Sterling, Ill. This plant is planned to produce approximately 600,000 cu.ft. of 560 B.t.u. gas per twenty-four hours when operated without steaming; and higher gas yields can, of course, be obtained if steaming of the ovens is desired.

The new type of oven is heated by producer gas generated in an outside producer. A system of heat regeneration similar to that used in the Becker-type horizontal oven, built by the same company, will be employed on the verticals. The ovens can be designed for either a single heating gas or of the "combination" type which permits interchange between oven gas and producer gas or blue water gas at the will of the operator.

This new oven is novel in the respect that the charge of coal enters directly into the hottest part of the oven without preliminary distillation. As a result a shell of coke is quickly formed around the softened coal mass and thus sticking of the coal to the oven wall is prevented. The experience at the Seaboard plant indicates that a wide variety of gas coals can be successfully carbonized, although some of these had previously been regarded as unsuitable for use in vertical ovens because of sticking or "hanging up" of the coal charge.

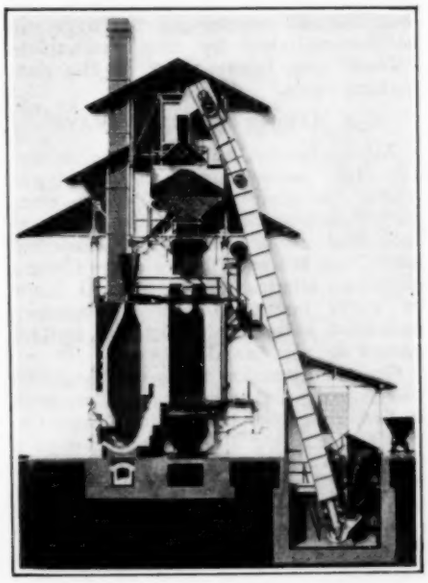


Fig. 1—Stettiner Vertical Oven

This intermittent oven now being introduced into the United States, is particularly for small and intermediate size plants and is widely used in Europe

Two gas off-takes are provided on each oven, connecting with separate gas collecting mains which have independent pressure regulation. The primary off-take at the top of the oven conveys rich gas from the initial distillation of the coal to an overhead collecting main. The secondary gas off-take located about ten feet below the top of the oven removes gases generated below the plastic zone of the coal and conveys them to a secondary collecting main. The two gases mix after passing through the separate pressure regulators, so that there is only a single condensing and by-product system.

Other New Coking Plants

Several other erecting companies demonstrated the merits of their systems at their exhibit booths or reported on them through the "Builders Section" of the carbonization committee. One of the most recent installations by The Gas Machinery Company, of Cleveland, is the Bryan, Ohio property of the Ohio Gas Light and Coke Co. The battery of ovens at this plant is made up of benches of three ovens each. Each oven, as shown in Fig. 2, is approximately 12½ in. wide, 8½ ft. high, and 13 ft. long measured through the coal space; and each holds a charge of 4,500 lb. of coal which is carbonized in approximately ten hours. The heating is by producer gas generated in a built-in producer, one producer serving each bench.

The most recent installation of Woodall-Duckham continuous vertical retorts, described by Isbell-Porter Company, is that built for the City of Holyoke, Massachusetts. The original installation here had a daily capacity of 720,000 cu.ft.; the new installation will have double this capacity but occupy only the same ground area. It consists of six benches of four vertical retorts each with a nominal throughput of 5 tons of coal per retort per day. A new rectangular heating-flue system is being used.

The new Foundation Oven Corporation coke and gas plant built for the Hudson Valley Coke and Products Corporation was described by the carbonization committee report. This battery

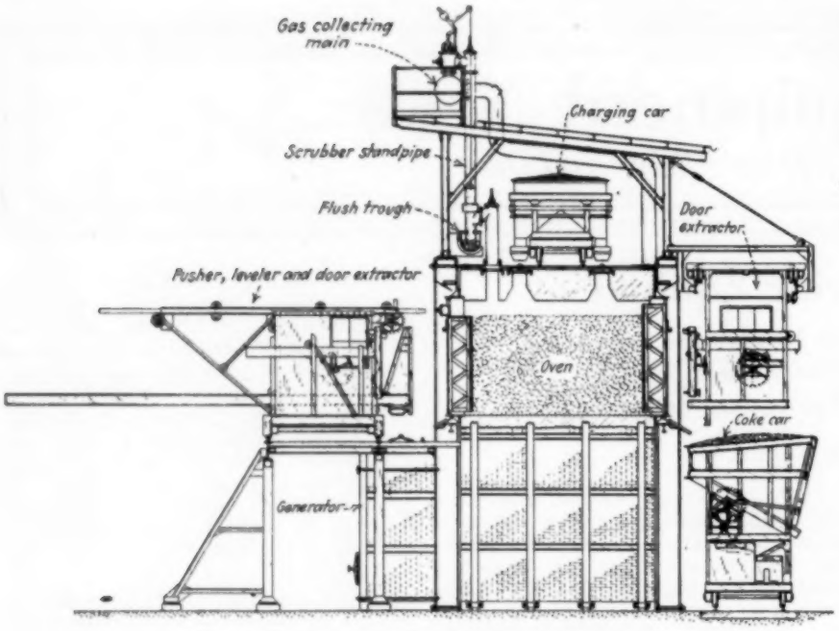


Fig. 2—Section Through Small Horizontal Gas Oven

This design, built by the Gas Machinery Co., is 12½ in. wide, 8½ ft. high and 13 ft. long and holds a charge of 4,500 lb. of coal which is carbonized in about ten hours.

consists of 55 "American Balanced-Draft" ovens arranged for firing with either oven gas, blue gas, or any mixture of these two. Each oven is approximately 14 in. wide, 14¾ ft. high, and 42½ ft. long, holding a charge of 14 tons which is coked in twelve hours. One of the novel features of the oven system is a new type of reversing mechanism which functions so easily that a very low horsepower motor suffices to operate it.

The West Gas Improvement Co. representatives described to their visitors four new vertical-retort plants using the Glover-West System which were completed during 1926. These plants are located at Toronto, Fall River, Fargo, and Portland (Maine). The Improved Equipment Co. announced that it was building a new plant, practically duplicating that at Darby, Conn., for the Adrian (Michigan) Gas Co.

The trend toward carbonizing equipment and away from water gas for new plant capacity was perhaps most strikingly emphasized by figures given out by the Koppers Co. This concern had built and put into operation up to June of 1926, 8,084 ovens, with an estimated annual carbonizing capacity of nearly 54,000,000 tons of coal. In addition to this there are now under construction 500 additional ovens with an annual capacity of approximately 4,000,000 tons of coal. This means that within a year there will be coal-gas capacity in the United States of more than 50 billion cubic feet above that at present available.

Self-Clinkering Water Gas Machines

Among all the varieties of water-gas equipment shown none attracted more attention than the model of an automatic-feed, self-clinkering water-gas generator shown by the Western Gas Construction Co. The feeding mechanism of this machine provides for introduction of weighed amounts of coal during each down run. The mechanism for weighing and feeding this coal is interlocked and automatically controlled by the machine mechanism so that the coal enters at exactly the right stage during the cycle.

The self-clinkering of this machine is accomplished by a rotary grate mechanism which has been tried out on a plant scale in the works of the Chicago By-Product Coke Co. A water-cooled plow mechanism is rotated in the base of the machine just above the grate. This plow discharges through the grate all fine ash and clinker and forces large clinkers against a crusher ring of alloy steel which forms a part of the base of the shell of the machine. Several months continuous operation in Chicago has demonstrated, it is claimed, that complete and regular ash discharge can be accomplished by this mechanism without any interruption of the gas-making cycle.

Gas Making to Be Automatic

All equipment builders are now apparently assuming that water-gas plant operation must be made completely automatic. The automatic coal feed and clinker discharge, described above, are but one further stage toward complete elimination of manual labor in works operation. Every company assumes automatic machine control except in very small works.

Greater attention is also being given to recording and indicating instruments to facilitate operation. The Bristol Co. was emphasizing a new adaptation of a long distance electric transmitting and recording system for use with a variety of its instruments. This type of apparatus has been used extensively in other fields, but only recently in the gas business. Another type of distant-indicating apparatus for liquid levels, gas holder position, and other uses was shown by the Electric Indicator Corporation. This system uses two or more synchronous motors, one at the point from which indications are desired and one at each point where record is to be made or indication shown. Any movement at the transmitting unit produces instantaneous and equivalent movement at the indicating or recording points automatically. This apparatus is apparently readily adaptable for use in distant indicating of positions or levels of holders, tanks, or on mechanisms of any other type.

A much simpler home-made scheme which sometimes can be utilized for observing holder positions was described by H. W. Schell of the Haverhill Gas Company. This company has found that placing a mirror at a suitable elevation on one of its scrubber units, the operating engineer is able to see the holder position from the operating floor.

The Bailey Meter Company was showing for the first time this year a new adaptation of its multiple-indicator gage for use in water-gas plants. It is claimed that this multiple indicator contributes greatly to safety and convenience by bringing together within a single case the various pressure and temperature indications that are commonly distributed over the whole instrument board with a wide variety of pointers and dials which tend to confuse the operator, especially in times of emergency.

Generator Refractories

Two types of ventilated refractory linings were shown by the Bernitz Furnace Appliance Co. and the Drake Non-Clinkering Furnace Block Co. The latter concern was calling particular attention to an eleven-foot water-gas generator at the Atlantic City Gas Company's works, where this system is in use.

The Drake lining shown in Fig. 3 is made up of silicon-carbide and Aluminax blocks which are perforated and with hollow back, permitting the by-passing of part of the air from the blast up through and behind the shell lining to keep the refractory cool. The cooling air is thus raised to a temperature of 800-900 deg. F. and thus becomes valuable pre-heated secondary air supply for the carburetor. It is claimed that this air-cooled lining reduces clinkering time by one half, because clinker adhesion is avoided. Shortening of clinkering time increases the gas making capacity, a result which is also aided by the increasing speed of carburetor heating when the secondary air is pre-heated.

Asbestos blocks for backing the high-temperature refractory in generators are now being used by practically all water-gas machinery builders, according to the representatives of Johns-Manville Co. The use of this material with higher thermal insulating power reduces the necessary thickness of fire clay, silica, or other refractory, and thus increases the inside diameter of the machine for given outer shell dimensions.

The Johns-Manville engineers were also presenting for the first time at this exhibit information on "Resisto" putty, Resisto primer, and Resisto paint. These materials were developed

by the company for use on its own plant equipment where protection of metal, tile, brick, wood, etc., was required against the action of moisture and acid fumes at temperatures not exceeding 250 deg. F. The materials are also said to be very satisfactory for coating the interior of water-gas generator shells before the asbestos-block lining is placed. Surfaces to be treated with either putty or paint should first be treated with a "primer" coat. The putty can be used for filling cracks, sealing over bolt heads, filleting of corners, and like work where a putty-like substance is needed. The paint can be brushed on over iron, refractory, or wood surfaces, over a primer coat. These materials are suggested for use on the walls of drying rooms, kilns, breaching and flues, gas ducts, machine hoods, drier housings, and like metal or wood parts exposed to moisture and chemical fumes, but not at temperatures running higher than 250 deg. F.

Waste-Heat Steam and Steam Storage

It was evident from the number of companies showing waste heat equipment that the waste-heat steam generator is now a recognized part of every water-gas and most coal-gas plants. Practically all of the erection companies previously mentioned were showing some variety of this equipment designed for use with their carbonizing or water-gas equipment. The LaMont Corporation, also, was showing a new type of waste-heat steam generator, automatic in operation and provided with some novel operating features. The West Gas Improvement Co. and the Bartlett Hayward Co. were both describing new installations which they had made of waste-heat boilers in gas works.

To stabilize plant operation and to reduce the steam-generating capacity needed for a given water-gas capacity. it is now recognized that some steam storage is desirable. The steam accumulator made by the Smoot Engineering Corporation is one of the new types of apparatus demonstrated at this year's exhibition for this purpose. This apparatus is intended to take in surplus steam which can accumulate during blast periods and release it automatically during the "run," when otherwise the boiler supply might not be adequate for the most efficient operation. The accumulator is intended, therefore, to act as a thermic flywheel and to offer steam reserve capacity. The successful functioning of this apparatus depends more than any thing else upon the accurate operation of the intake and discharge mechanism.

General Chemical Engineering Equipment

A multi-stage gas booster was shown as a recent development by Mr. G. W. Allen, of the B. F. Sturtevant Company. This booster is intended to produce higher pressures than are feasible with single stage units without excessive speeds. It is claimed that the multi-stage type is freer from pulsation than any positive pressure blower of equivalent capacity.

The same contributor suggested a new scheme for avoiding surging with centrifugal blowers, especially as these blowers are hooked up in a typical water gas plant. This arrangement is illustrated in the diagram in Fig. 4. The stem of the generator blast valve is connected by suitable interlinkage to a blast relief gate which is located on the up-stream side of the generator blast valve. As the generator blast valve closes, the blast relief gate opens allowing the air to escape to the atmosphere, thus preventing the noisy surges in the blast line that are otherwise likely to occur.

Two Emergency Devices

As an aid to patching a holder without putting it out of service when a bad leak is encountered it was suggested by W. Warner of the Brooklyn Union Gas Company that the leaking spot be closed with canvas temporarily. To draw this canvas into place

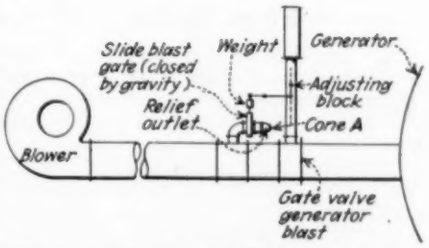


Fig. 4—Scheme for Avoiding Surging with Centrifugal Blowers

two holes are drilled through the holder above the leak and wires dropped down inside and fished out under the lower edge of the holder shell. A piece of canvas of the requisite size is then drawn in under the bottom edge of the holder to such point that it will fall over the leak and close it from inside the holder. Attaching of a permanent patch on the outside of the shell is not interfered with even though the leaking spot is raised above the level of the sealing liquid. When the leak has been permanently closed the canvas can be allowed to slip down and be fished out under the lower edge of the shell and the two drill holes are then easily closed with tap bolts. By this means serious leaks which could not otherwise be handled while the gas was in the holder may be handled without danger to the workmen.

Quick renewal of explosion heads for generator blast lines is possible with a scheme developed and reported by E. L. Hall of the Portland Gas and Coke Company, Portland, Ore. To use this scheme the canvas of the head is mounted on the explosion flange by means of a bolted ring which slides in and out of the flange mounting, where the whole flange is held in place by hand wheels. A spare flange ready to insert is kept at all times available and changes of the canvas itself can be done at leisure. Emergency changes thus can be made in but a few minutes at most.

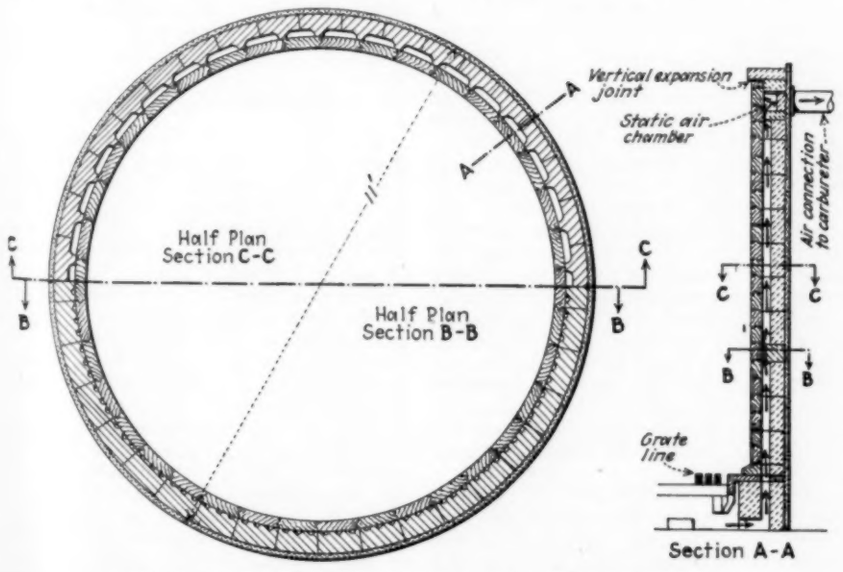


Fig. 3—Special Refractory Lining for Water Gas Generators

The blocks are perforated and have hollow backs, permitting the bypassing of part of the air blast through and behind the lining, thus keeping the refractories cool.

Continuous Weigher

The Schaffer Poidometer Co., 2828 Smallman St., Pittsburgh, Pa., are manufacturing a new type of Poidometer for handling such materials as hot clinker, stone, coke and other sharp and abrasive materials. In place of a rubber belt and pulleys, this machine is equipped with cold rolled steel flights mounted on two strands of 1 in. pitch steel roller chain, operating over cut tooth sprockets.

These machines are manufactured in two widths. The 20 in. width has a capacity of 40 tons per hour on such materials as stone and clinker, provided it is crushed to 1½ in. and finer, while the 36 in. machine has a capacity of 150 tons per hour on the same material when sized 4 in. and finer.

Both this new machine and the older types are now being equipped with a new design of "Productimeter," mounted on the side of the hopper, which gives the operator a clearer view of the amount of material handled in any given unit of time.

Flow Meter

An instrument for indicating, recording and integrating fluid flow by electrical means has been developed by the Brown Instrument Co., Philadelphia, Pa. It consists essentially of an electro-magnetic manometer in which the U-tube, mercury filled, is connected across an orifice inserted in the pipe line through which the flow occurs, an indicating meter, and a recording and integrating meter. Because of the electrical connection between the manometer and the meters, these instruments can be placed in any desired location.

The U-tube operates by the differential pressure caused by the flow through the orifice. In one leg of this tube is a float that rides on the surface of the mercury. This float is made of a non-corrodable metal and the tube in which it rides is lined with ribbed, molded Bakelite, both insuring freedom of motion. An armature of laminated iron is supported by the float by means of a non-magnetic rod, being raised and lowered with the float. This armature travels inside of a non-magnetic tube in which the pressure of the fluid being metered is also confined. A split, two-part inductive winding is placed over the outside of this tube and is under atmospheric conditions only, being protected by a simple cover.

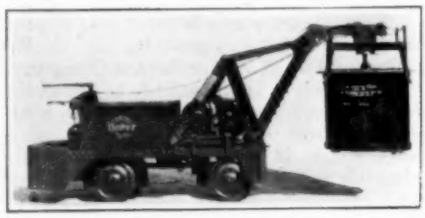
The outer ends of this winding are connected directly across the service mains of an alternating current supply line, and connections are run from these ends directly to the outer ends of a similar divided inductance coil at the indicating meter, and another similar coil at the recording meter. Armatures are hung on counter-balanced arms in these two meters. The points of connection between the two parts of these three sets of coils are all connected together by a neutral wire and when thus connected the coils form the self-adjusting inductance bridge which is the feature of this flow meter.

When the armature in the manometer is raised or lowered by a change in flow through the orifice, the relations between the voltages across the two parts of the winding at this manometer are changed. This causes the currents in the two parts of the windings in the two instruments also to change to a similar degree with the result that the armature of the indicator and the recorder move to new positions and consequently give new readings on the two meters.

The integrator which is part of the equipment is designed so that it increases the counter readings in proportion to the square root of the angular deflection of the recorder pen arm, this being the relation of flow to the pressure difference across the orifice. Attached to the gear train which drives the recorder chart is a sector of a disk which rotates at a constant rate. A roller is normally held up by a latch out of contact with this sector. The latch is tripped when the sector is in different positions dependent upon the rate of flow and the roller is rotated through an angle proportional to the rate of flow before the sector passes out of contact with it. After the sector passes beyond the roller the latter is again latched in place. This process is repeated at regular intervals.

The square root relation existing between rate of flow and pressure difference is reproduced in the relation between the angular travel of this disk and the pen deflection by means of an appropriate mechanism. This mechanism causes a recording pen to make a jog in its record line, every tenth jog being in the opposite direction so that the record can be read with ease.

This instrument can be supplied with record charts and manometers arranged to suit various ranges of flow as desired.



Special Charging Truck

Charging Truck

The accompanying photograph shows a crane type of electric truck designed by the Baker-Raulang Co., Cleveland, Ohio, for charging operations. This machine operates in connection with Chisholm & Moore 1 ton charging buckets and makes use of the Morgan patented bucket yoke.

The truck itself is assembled principally of standard Baker parts; that is, the axles, controller, automatic switch, hoist, hoist controller, limit switch, etc., are all inter-standardized with all other models of Baker trucks and tractors. The motors receive power from a 48-volt storage battery contained in the large steel box near the driver's end of the truck.

The Morgan charging bucket is circular in shape with a conical bottom. In operation the bucket is loaded and picked up by means of an eye fastened to the center of the bottom. When it is raised the four dogs on the yoke engage with the angle iron ring around the top of the bucket. To discharge the bucket it is only necessary to reverse the power on the hoist. This lowers the bottom while the shell is held up by the yoke. Because of the conical shape of the bottom the charge is spread evenly around the cupola. To place the bucket back on the floor the bottom is raised until it engages the shell and raises the ring clear of the dogs. The dogs are then held clear of the ring by means of the chain leading back to the operator's position while the bucket is being lowered. The upward travel of the hoist is protected with an automatic safety switch which cuts off the power when the bucket has been raised so that the ring is one inch above the dogs.

The boom is strengthened with a steel plate on the side toward the fire. This keeps the heat away from the cable and also away from the hoist and other truck operating parts. The cable is a special steel center rope suited for this purpose.

Refractory Material

A new refractory material known as "Plibrico Stucco" for the maintenance of brick or monolithic furnace walls and arches has been developed by the Plibrico Jointless Firebrick Co., 1130 Clay St., Chicago, Ill. It is applied to the wall or arch whenever the furnace is shut down, replacing that part of the lining that has been worn away through use.

The material is applied in thin coats with a trowel. Sometimes several coats are necessary; but each coat must be thin, for if too thick a coat is applied it will not adhere to the wall. It can only be used where very high furnace temperatures are attained, but, under proper conditions is said to greatly lengthen the life of furnace walls and arches.

Pipe Threader

A pipe threader for the larger sizes of pipe has recently been brought out by the Oster Mfg. Co., Cleveland, Ohio, and is known as the No. 44 Receder. It is claimed that this tool has easy cutting qualities because of its narrow dies which are ground with an extra long lead and sharp rake. To further increase the ease of cutting the tool is geared and is furnished with a ratchet handle so that one man is said to be able to cut 4-in. pipe without undue effort. A leader screw protected by a chip shield starts the dies on the pipe and pulls them along producing proper pitch and taper. This screw because of the shield which keeps it free from dirt and chips is protected from undue wear, which is said to materially reduce the wear and thus increase the life of the device.

A lever-operated, self-centering chuck is provided which makes it unnecessary to change the bushings when cutting different sizes of pipes. This chuck is designed for use with pipes of 2¼ to 4 in. in diameter which is the range of the tool. Short nipples can be threaded as the bore of the stock is large enough to accommodate a 4-in. coupling.

Fahrenwald Sizer

The Dorr Co., 237 Park Avenue, New York, N. Y., has recently announced that it has taken over the manufacture and selling of the Fahrenwald Sizer, an hydraulically operated machine that was developed by A. W. Fahrenwald of the U. S. Bureau of Mines.

This machine is a new development in the field of hindered-settling classification and is used for preparing feed for concentrating tables. It is said to have effected a marked improvement in table operation. It contains six pockets or compartments each having straight non-slipping sides so that the velocity of the water is uniform over the whole area. The spigot discharge valve is controlled by a diaphragm sensitive to every change of condition in the pockets thus insuring uniform quality of the product. The water requirements are low and once adjusted the device is said to be automatic in

operation and will start up after a shutdown without necessitating much supervision.

The applications claimed for this device are as follows: It will take an unsized feed in which the particles are of uniform specific gravity and deliver a number of closely-sized products. It will take an unsized feed in which the particles are not of uniform specific gravity and will deliver a series of hydraulically classified products. It will take a sized feed in which the particles are not of uniform specific gravity and separate the particles according to gravity, or in other words make a concentration of the material by weight of particles.

Manufacturers' Latest Publications

Homestead Valve Mfg. Co., Homestead, Pa.—A booklet entitled "Valve Economy" describing valves made by this concern and their applications.

Morey, Jones & Lovell, 810 West 6th St., Los Angeles, Calif.—Bulletin No. 203—A bulletin on the flow indicator made by this company for the measurement of flow of either gas or liquid.

Southern Manganese Steel Co., St. Louis, Mo.—Catalog of the heat and corrosion resisting alloy products made by this concern under the trade name of Fahralloy.

Dings Magnetic Separator Co., Milwaukee, Wis.—A new folder describing the Dings magnetic pulley for the extraction of tramp iron.

Automatic & Electric Furnaces, Ltd., 153 Farringdon Road, London, E. C. 1, England.—A new catalog of Wild-Barfield electric furnaces for all purposes.

The Plumbago Crucible Manufacturers' Publicity Bureau, 90 West Street, New York, N. Y.—A booklet entitled "How to Make an Inexpensive Storage Oven," describing a method for obtaining proper storage for crucibles.

Armco Culvert & Flume Mfrs. Assn., Middletown, Ohio.—A booklet entitled "An Anniversary of Significance," being an account of 30 years activities of this organization.

The Truscon Laboratories, Detroit, Mich.—A folder describing the use of Stone-Tex, for protecting concrete and masonry walls against frost.

General Electric Co., Schenectady, N. Y.—Several bulletins as follows: GEL-91, entitled "An Industry Comes to Electricity for its Heat" being illustrations of the application of electric heat in various industries; GEL-98, a pamphlet entitled "Motorized Power" being an account of various applications of motors for conveying and other purposes of a similar nature; GEA-233, a bulletin describing single-stage centrifugal air compressors; GEA-334, bulletin of variable voltage control system for gearless traction elevators; GEA-454, bulletin describing automatic arc welding apparatus for small tanks; GEA-455, a bulletin describing automatic arc welding apparatus for large tanks and pipes; GEA-484, a bulletin of control equipment for charging storage batteries.

Steere Engineering Co., Detroit, Mich.—Several bulletins as follows: No. 290, describing charging doors for water-gas machines; No. 291 describing clinker, ash and cleanout doors for water-gas machines; No. 297, describing steam and oil systems for water-gas machines; No. 301, describing gage boards and instruments for use with carbureted water-gas machines.

Denver Fire Clay Co., Denver, Colo.—A pamphlet describing muffles, crucibles and other clay products sold by this concern.

Belke Mfg. Co., 2952 West Van Buren St., Chicago, Ill.—A pamphlet describing electroplating devices made by this concern.

Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.—New publications as follows: Folder No. 4474, describing the babbitting of bearings and explaining the use of automatic electric babbitting pots made by this company; leaflet No. 20292, describing type MF motor starting oil circuit-breakers. This company has also recently revised the following leaflets: L3549-B, L-20135-A and L20011-A.

Crouse-Hinds Co., Syracuse, N. Y.—New publications as follows: Folder No. 42, a folder describing vapor-proof condulets; folder No. 43, a folder describing plug receptacle and safety switch condulets; also, advance sheets Nos. 11, 20, 24, 26B, 27, 29, 39, 67, 68, 69, 70, 71, 72, 73, 74, 75 and index, being descriptive sheets on various types of equipment made by this company.

The Surface Combustion Co., 366 Gerard Ave., New York, N. Y.—A new book entitled "Data on Industrial Heating Processes" being a book of several hundred pages giving combustion data, engineering data, and information on burners, furnaces and auxiliary equipment. This book is a comprehensive treatment of the subject and contains much information of value to engineers and others who operate industrial furnaces.

Newark Wire Cloth Co., Newark, N. J.—A new general catalog of the equipment made by this company.

The Fafnir Bearing Co., New Britain, Conn.—A new booklet describing the equipment of electric motors with ball bearings and pointing out some of the advantages obtained in this way.

Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.—A new price list and index to apparatus and instruments made by this concern.

The Grating Co. of America, Pittsburgh, Pa.—A pamphlet on Tri-Lok steel gratings and treads.

Bethlehem Steel Co., Bethlehem, Pa. — Booklet No. 113—A catalog of stainless steel and stainless iron describing the properties and applications of these materials.

Patterson Foundry & Machine Co., East Liverpool, Ohio.—A booklet entitled "Modern Paint Making by the Patterson Method," describing machinery made by this company for the paint factories; also a leaflet showing several types of agitators made by this company.

The Dust Recovering & Conveying Co., Cleveland, Ohio.—Bulletin No. 14—Description of the use of equipment made by this company in baghouses for fume recovery.

Chicago Pneumatic Tool Co., 6 East 44th St., New York, N. Y.—Bulletin No. 851—Bulletin describing the design and operation of the Type CP-5 drifter.

Merco Nordstrom Valve Co., 110 West 40th St., New York, N. Y.—Catalog No. 5—A new general catalog of lubricated plug valves, giving description of various types of these valves made of different metals and the purposes for which they are useful. Also an appendix on the different kinds of special lubricants available for different kinds of service.

Taylor Instrument Co., Rochester, N. Y.—A new general catalog of the various types of instruments manufactured by this company and their applications.

Manitowoc Engineering Works, Manitowoc, Wis.—A pamphlet describing the Minogue agitator for use in the manufacture of cement.

Edwin L. Wiegand Co., Pittsburgh, Pa.—Two new catalogs, the first describing Chromalox air heaters for room heating and similar purposes, and the second being a revised issue of the bulletin entitled "How and Where are Chromalox Heating Units Being Used."

Cleveland Crane & Engineering Co., Wickliffe, Ohio.—A pamphlet illustrating the use of the "Cleveland Tramrail System" in various industries.

Drying Systems, Inc., 1800 Foster Ave., Chicago, Ill.—A folder describing the Phoenix constant-effect air filter and the National rotary air filter made by this company.

American Solvents & Chemical Corp., 285 Madison Ave., New York, N. Y.—A booklet entitled "Alcohol for Industrial Purposes" describing the properties and use of various formulas of denatured alcohol.

Roller-Smith Co., 233 Broadway, New York, N. Y.—Bulletins Nos. 210 and 150—Two bulletins describing the type HTA portable a.c. voltmeters, type HA a.c. single phase, and d.c. wattmeters, and type HTD portable d.c. instruments.

Marsh Electro Chlorination Co., 101 Park Ave., New York, N. Y.—A leaflet describing Marsh apparatus for electric sanitation and purification of water and other liquids.

American Engineering Co., Philadelphia, Pa.—A new general catalog of the "Lo-Hed" electric hoist and monorail crane equipment, giving specifications and applications.

C. J. Tagliabue Mfg. Co., 18 Thirty-third St., Brooklyn, N. Y.—Catalog No. 625A—A revised edition of the condensed catalog of industrial thermometers manufactured by this concern.

La Mont Corporation, 200 Fifth Ave., New York, N. Y.—A catalog of waste-heat steam generators for carbureted water gas, blue gas, producer gas, and oil-gas plants, and the La Mont duplex steam-sealed valve.

Buffalo Forge Co., Buffalo, N. Y.—Catalog No. 466—A catalog describing the apparatus and methods used in heating industrial plants by means of the unit heaters manufactured by this concern.

The Timken Roller Bearing Co., Canton, Ohio.—A catalog entitled "Timken Engineering Journal" being the first 64 pages of a loose-leaf collection of engineering data on the design and use of roller bearings.

Celite Products Co., 11 Broadway, New York, N. Y.—Bulletin No. 103—A catalog of the properties and application of Sil-O-Cel insulating brick.

American Blower Co., Detroit, Mich.—Bulletin No. 2223—A bulletin on air filters made by this company for use with blowers, compressors and other apparatus.

United Filter Corp., Hazleton, Pa.—A new engineering bulletin describing modern methods of contact filtration in the petroleum industry.

Harry N. Perry, 702 No. Main Street, Los Angeles, Calif.—A bulletin describing the "Belt-Slacker," a short-center belt drive for various types of power-driven equipment.

Connersville Blower Co., Connersville, Ind.—Bulletin No. 43—A bulletin on rotary displacement meters of special types for special service in measuring air or gas.

Thompson Grinder Company, Springfield, Ohio.—Bulletin No. 1—A bulletin describing the R. R. Moore fatigue machine, a device for determining the resistance of material to repeated stresses.

Lincoln Electric Co., Cleveland, Ohio—Bulletin describing the design and use of various types of automatic electric arc welding equipment.

The New Departure Mfg. Co., Bristol, Conn.—A new catalog entitled "Cutting Your Costs" describing the use of ball bearings in motors; also, 8 pages for this company's loose-leaf engineering data file describing the application of ball bearings in electric motors.

Kennedy-Van Saun Mfg. & Engineering Corp., 50 Church Street, New York, N. Y.—Bulletin describing the gyratory crushers made by this concern.

Andrews-Bradshaw Co., Pittsburgh, Pa.—Bulletin No. 39—A bulletin giving standard specifications for clean and dry steam.

Bristol Co., Waterbury, Conn.—Catalog No. 1502-Voltmeter Section—Part of this company's new general catalog of recording electrical instruments.

Bacharach Industrial Instrument Co., Pittsburgh, Pa.—Bulletin No. 253—Bulletin describing the use of the Bacharach electric CO meter for carburetor adjustment of high-speed internal combustion engines.

Adam Hilger, Ltd., 24 Rochester Place, London, N. W. 1, England.—Bulletins D and E—The first of these bulletins describes wave length spectrometers, monochromators and specialized spectroscopes; while the second is devoted to describing a new series of spectographs.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin No. 1229—A bulletin describing the design and application of attrition mills made by this company.

Oliver Continuous Filter Co., San Francisco, Calif.—Bulletin 20—A new catalog on the design and application of various types of filters made by this concern.

International Nickel Co., 67 Wall Street, New York, N. Y.—Pamphlet No. 8—A bulletin containing an article on the improvement of gray cast iron by the addition of nickel.

The Cutter Co., Philadelphia, Pa.—A book entitled "Experience is Master" giving a description of the organization and personnel of this company.

Century Electric Co., St. Louis, Mo.—A pamphlet on Century repulsion start induction single phase motors and data sheets 2-7, 7-7, and 21-21 covering types RF, FC and AS motors.

Thyle Machinery Co., San Francisco, Calif.—Bulletin No. 20—A bulletin describing the Bradley automatic valve for the automatic control of underflow from thickeners, settlers or classifiers.

American Pulverizer Co., St. Louis, Mo.—Leaflets describing the No. 13 ring pulverizer, the ring coal crusher, and other types of ring pulverizers made by this company from size 15 to size 48.

Esterline Angus Co., Indianapolis, Ind.—Bulletins Nos. 926 and 1026—Two new bulletins describing the use of graphic recording electrical instruments.

Terry Steam Turbine Co., Hartford, Conn.—Bulletin S-80—A new bulletin describing the operation and application of multi-stage turbines, illustrating methods of securing lost-cost power as a byproduct of process steam.

Brown Instrument Co., Philadelphia, Pa.—A folder describing the new design of electric flow meter recently brought out by this concern.

Foxboro Co., Inc. Foxboro, Mass. — A folder describing various types of recording instruments made by this company.

Patents Issued Oct. 19 to Nov. 2, 1926

Paper and Wood Pulp

Paper Making. Lewis Graffiin, Lockland, Ohio, assignor to The Bauer Bros. Company, Springfield, Ohio.—1,603,534.

Process and Apparatus for Filtering Wood Pulp. James Brookes Beveridge, Richmond, Va.—1,603,507.

Pulp-Saving Device for Paper Mills. Harold B. Wadsworth, deceased, late of New York, N. Y., by Jessie B. Wadsworth, executrix, New York, N. Y.—1,604,250.

Rubber

Accelerator for the Vulcanization of Rubber and Method of Making the Same. Lorin B. Sebrell, Akron, Ohio, assignor to The Goodyear Tire & Rubber Company, Akron, Ohio.—1,604,199.

Method of Vulcanizing Caoutchouc and Product Produced Thereby. Clarence M. Carson, Akron, Ohio, assignor to The Goodyear Tire & Rubber Company, Akron, Ohio. —1,603,317.

Rubber Isomer and Method of Producing the Same. Harry L. Fisher, Akron, Ohio, assignor to The B. F. Goodrich Company, New York, N. Y.—1,605,180.

Process of Manufacturing a Rubberized-Fiber Composition. John T. Charleson, Akron, Ohio, assignor to The Goodyear Tire & Rubber Company, Akron, Ohio.—1,603,318.

Incorporating Cords in Rubber Sheets. Thomas Midgley, Hampden, Mass., assignor to The Fisk Rubber Company, Chicopee Falls, Mass.—1,605,453.

Method of Making a Rubberized Fiber Composition. James M. Gillet, Milwaukee, Wis., assignor to The Goodyear Tire & Rubber Company, Akron, Ohio.—1,603,335.

Petroleum Refining

Refining of Petroleum Oils and Distillates. Paul McMichael, Flushing, N. Y., assignor to Hydrocarbon Refining Process Company, Inc., New York, N. Y.—1,603,701.

Process for Removing Sulphur Compounds from Petroleum Oils. Leland L. Odom, Little Rock, Ark., assignor, by direct and mesne assignments, to M-O-R Products Company.—1,604,235.

Apparatus for Cracking Oil. George L. Prichard, Port Arthur, Tex., assignor to Gulf Refining Company, Pittsburgh, Pa.—1,605,063.

Oil-Shale Retort. Clarence E. Barnhart, San Francisco, Calif.—1,604,253.

Treatment of Acid Sludge. Ralph A. Halloran, Berkeley, William N. Davis, Oakland, and George A. Davidson, Berkeley, Calif., assignors to Standard Oil Company, San Francisco, Calif.—1,604,641.

Process of Manufacturing a Non-Emulsifiable Mineral Oil of High-Dielectric Strength. Harold T. Maitland, Sharon Hill, Pa., assignor to Sun Oil Company, Philadelphia, Pa.—1,605,046.

Means and Method for Removing Deposited Material from Cracking Apparatus. Lyman C. Huff, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill.—1,603,541.

Fuels and Furnaces

Gas Manufacture. Sybren R. Tymstra and Olav Tweit, Detroit, Mich., assignors to Steere Engineering Company, Detroit, Mich.—1,605,083.

Coking Process. Frederick W. Sperr, Jr., Pittsburgh, Pa., assignor to the Koppers Company.—1,605,378.

Motor Fuel. Charles F. Kettering and Thomas Midgley, Jr., Dayton, Ohio, assignors, by mesne assignments, to General Motors Corporation, Detroit, Mich.—1,605,664.

Method of Manufacturing Improved Bituminous Product. Daniel B. W. Alexander, Springfield, Mass.—1,603,502.

Coke Oven and Process of Operating Same. Carl Otto, Essen-on-the-Ruhr, Germany.—1,603,793.

Coking Retort Oven. Max Sommer, Essen-Ruhr, Germany.—1,603,992.

Organic Processes

Process for the Manufacture of Tartaric Acid. Géza Zemplén, Budapest, Hungary, assignor to Chemische Fabrik Dr. Hugo Staltzenberg, Hamburg, Germany.—1,605,-419.

Process for the Manufacture of Alkyl Carbonates. John A. S. Hammond, Woodlawn, Md., assignor to U. S. Industrial Alcohol Co.—1,603,689.

Method of Manufacturing Alkyl Carbonates. Harry Gilbert Mitchell, Baltimore, Md., assignor to U. S. Industrial Alcohol Co.—1,603,703.

Bismuth Compound of Aminophenols and Process of Making Same. Max Bockmühl, Hochst-on-the-Main, and Wilhelm Heinrich Ludwig, Frankfort-on-the-Main, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort, Germany.—1,604,-143.

Process for the Reduction of Alkyl Esters. Maurice Ernest Bouvier and Emile Blanc, Lyon, France, assignors to Société Chimique des Usines du Rhone, Paris, Franc.—1,065,093.

Nitrocellulose Film and Process of Making the Same. John A. Wilson, Elizabeth, N. J., assignor to Duratex Corporation, Newark, N. J.—1,603,499.

Manufacture of Artificial Silk and the Like from Viscose Solutions. William Porter Dreaper, Hampstead Heath, London, England.—1,604,889.

Making Cellulose Esters of Carboxylic Acids. Donald Archer Nigthingale, Ambler, Pa., assignor to the Ketoid Company, Wilmington, Del.—1,604,471.

Alkali-Metal Salts of Mercurized Phenols for Treating Seed. August Klages, Madgeburg-Sudost, Germany.—1,604,778.

Carbon-Producing Apparatus. George W. Davisson, Idamay, Ky.—1,604,148.

Casein Glue. Henry L. Prestholdt, Minneapolis, Minn.—1,604,307.

Inorganic Processes

Quick-Setting Lime Products. Major E. Holmes and Gail J. Fink, Washington, D. C., assignors to National Lime Association, Washington, D. C.—1,604,574.

Production of Quick-Setting Lime Products by the Addition of Carbonates. Major E. Holmes and Gail J. Fink, Washington, D. C., assignors to National Lime Association, Washington, D. C.—1,604,575.

Production by Carbonation and the Addition of Sulphates of Plastic Materials Having an Initial Quick Set. Frank C. Mathers, Bloomington, Ind., and Russel L. Hardy, Woodville, Ohio, assignors to National Lime Association, Washington, D. C.—1,604,576.

Quick-Setting Lime and Process of Making Same. John W. Stockett, Jr., Washington, D. C., assignor to National Lime Association, Washington, D. C.—1,604,577.

Process for the Gaining of Hydrocyanic Acid from Gaseous Mixtures Containing Hydrocyanic Acids. Otto Liebknecht, Frankfort-on-the-Main, Germany, assignor to The Deutsche Gold- & Silber-Scheideanstalt vormals Roessler, Frankfort-on-the-Main, Germany.—1,605,897.

Recovery of Zinc as Sulphate from Dross. Jesse Oatman Betterton, Omaha, Neb., assignor to American Smelting and Refining Company, New York, N. Y.—1,605,640.

Manufacture of Aluminum Chloride. Richard J. Dearborn, Summit, N. J., assignor to The Texas Company, New York, N. Y.—1,605,098.

Method and Apparatus for Making Salt. Hugh T. Reid, Cleveland, Ohio.—1,605,375.

Catalyst for the Synthesis of Ammonia. Charles Urfer, Geneva, Switzerland.—1,605,875.

Synthesis of Ammonia. Georges Claude, Paris, France, assignor, by mesne assignments, to Lazote, Inc.—1,605,647.

Process of Producing a Titanium Pigment. Reginald Hill Monk, Montreal, Quebec, Canada, assignor of one-half to John Irwin, Montreal, Canada.—1,605,851.

Process for the Simultaneous Recovery of Nitric Oxide and the Production of Alkali-Metal Nitrate and Hydrochloric Acid. William H. Ross, Washington, D. C., and Arnon L. Mehring, Hyattsville, Md.—1,604,660.

Manufacture of Sulphuric Acid. Edson R. Wolcott, Los Angeles, Calif., assignor to The Texas Company, New York, N. Y.—1,605,088.

Manufacture of Aluminum Sulphate. Harold Norman Spicer, New York, N. Y., assignor to The Dorr Company, New York, N. Y.—1,604,427.

Method of Calcining and Clinkering Cement-Forming Materials. Robert D. Pike, San Francisco, Calif.—1,605,279.

Method of Making Arsenic Acid. Howard W. Ambruster, Westfield, N. J.—1,603,308.

Process of Recovering Iodides from Adsorptive Charcoal Containing Iodine. Frits Ellinger, The Hague, Netherlands, assignor to Bouw Maatschappij, Soerabaya, Java, Dutch East Indies.—1 604,153.

Method for Producing Synthetic Precious Stones. Otto Ruff, Breslau, Germany.—1,605,073.

Arseno-Bismuth Compound and Process of Making Same. George W. Raiziss and Abraham Kremens, Philadelphia, Pa., assignors to Abbott Laboratories, Chicago, Ill. —1,605,691.

Process for Producing Nonsag Tungsten Wire. Paul McAllister, Bloomfield, N. J., assignor to Westinghouse Lamp Company. —1,605,192.

Electrolyte and Method of Making the Same. Adolph Miller, Kirkwood, Mo.—1,605,756.

Depolarizing Composition and Process of Making the Same. George W. Heise, Bayside, N. Y., assignor to National Carbon Company, Inc.—1,605,582.

Battery Electrode. David Pepper, Philadelphia, Pa.—1,603,291.

Equipment and Processes

Apparatus for Making Sheet Glass. Frederick Gelstharp, Tarentum, Pa., assignor to Pittsburgh Plate Glass Company.—1,603,946.

Method and Apparatus for Forming Sheet Glass. George E. Howard, Butler, Pa., assignor to Hartford-Empire Company, Hartford, Conn.—1,605,736.

Process of Making Sheet Glass. Lee Showers, Charleroi, Pa., assignor to Pittsburgh Plate Glass Company.—1,603,989.

Method and Apparatus for Delivering Viscous Glass. Oliver M. Tucker and William A. Reeves, Columbus, Ohio, assignors, by mesne assignments, to Hartford-Empire Company, Hartford, Conn.—1,604,000.

Art and Apparatus for Ultimate Destructive Distillation of Organic Matter. William K. Ljungdahl, Portland, Ore., assignor to Albert W. Cooper, Portland, Ore.—1,603,343.

Kiln for the Continuous Destructive Distillation of Organic Material. William K. Ljungdahl, Bend, Ore., assignor to Albert W. Cooper, Portland, Ore.—1,603,346.

Apparatus for Distillation. William K. Ljungdahl, Portland, Ore.—1,603,344.

Distilling Apparatus for Volatile Liquids. Henry A. Hills, Grand Rapids, Mich.—1,604,353.

Process of Separating Volatile Chemicals. Walter E. Lummus, Lynn, Mass.—1,603,851.

Treatment of Carbonaceous Material. Harald Nielsen, Muswell Hill, England, assignor of one-half to Bryan Laing, Hatfield, England.—1,605,761.

Bubble Tower. Raymond B. Millard, Los Angeles, Calif., assignor, by direct and mesne assignments, to Southwestern Engineering Corporation, Los Angeles, Calif.—1,605,263.

Equalizing System for Bubble Towers. Raymond B. Millard, Los Angeles, Calif., assignor, by direct and mesne assignments, to Southwestern Engineering Corporation, Los Angeles, Calif.—1,605,264.

Bubble Tower.—Raymond B. Millard, Los Angeles, Calif., assignor, by direct and mesne assignments, to Southwestern Engineering Corporation, Los Angeles, Calif.—1,605,265.

Apparatus for the Liquefaction and Separation of the Constituents of Gaseous Mixtures. Claude C. Van Nuys, Cranford, N. J., assignor to Air Reduction Company, Incorporated, New York, N .Y.—1,604,248.

Process of Separation of Gases Liquefying at Different Temperatures. Georges Claude, Paris, France, assignor, by mesne assignments, to Lazote, Inc.—1,605,646.

Apparatus for Liquefaction and Rectification of Gases. Claude C. Van Nuys, Cranford, N. J., assignor to Air Reduction Company, Incorporated, New York, N. Y.—1,604,249.

Drier. Walter M. Schwartz, Philadelphia, Pa., assignor to Proctor & Schwartz, Incorporated, Philadelphia, Pa.—1,604,079.

Drier. Thomas H. Rhoads, Philadelphia, Pa., assignor to Proctor & Schwartz, Incorporated, Philadelphia, Pa.—1,604,074.

Art of Separating Suspended Matter from Gases. Milton W. Cooke, Pittsburgh, Pa.—1,605,648.

Conical Crushing Mill. Charles F. Smith and Harvey H. Rumpel, Milwaukee, Wis., assignors to Smith Engineering Works, Milwaukee, Wis.—1,605,007.

Heat Exchanger. John Primrose, Richmond, N. Y., assignor to Power Specialty Company, New York, N. Y.—1,605,612.

Solvent Recovery. Arthur B. Ray, Bayside, N. Y., assignor to Carbide and Carbon Chemicals Corporation.—1,604,481.

Absorption and Cooling Apparatus. Friedrich Plinke, Charlottenburg, Germany, assignor to General Ceramics Company, Keasbey, N. J.—1,605,564.

Precipitating Apparatus. Ingenuin Hechenbleikner, Charlotte, N. C.—1,604,553.

Filter and Filter Cleaner. Hiram Wheeler Blaisdell, Los Angeles, Calif., assignor to The Blaisdell Filtration Company.—1,604,379.

News of the Industry

International Conference on Bituminous Coal

The list of speakers for the International Conference on Bituminous Coal to be held at the Carnegie Institute of Technology November 15-18 according to the latest program announcements from President Thomas S. Baker includes some of the most representative scientists and engineers in the world engaged in coal problems.

Among these who have accepted invitations to speak are Dr. Friedrich Bergius, of Heidelberg, Germany, inventor of the Bergin method of producing petroleum from coal; Professor Franz Fischer, director of the Institute of Coal Research, at Mulheim-Ruhr, Germany, inventor of a process for making synthol from coal; General Georges Patart, of Paris, France, inventor of a process for making methyl alcohol from coal; Jean Bing, director of technical service, Coal Tar Products and Distillers Association, Paris, France; Dr. C. H. Lander, director of fuel research of the Department of Scientific and Industrial Research, England; Dr. R. Lessing, consulting engineer, London; Geoffrey M. Gill, fuel technologist and gas specialist, London; and Harald Nielsen, of Sensible Heat Distillation, Ltd., London, inventor of the L. & N. Process of distillation.

In addition to these, a list of American speakers includes A. C. Fieldner, chief chemist of the U. S. Bureau of Mines, and superintendent of the Pittsburgh Experimental Station; O. P. Hood, chief mechanical engineer of the U. S. Bureau of Mines; Dr. Louis C. Jones, Nitrogen Engineering Corporation; M. R. Campbell, U. S. Geological Survey; Professor S. W. Parr, University of Illinois; Osborn Monnett, smokeless fuel specialist of Chicago; Emil Piron, who installed the distillation plant for the Ford company; Walter E. Trent, Henry Kreisinger, Dr. Walter Runge, S. R. Church, George A. Orrok, John M. Weiss, Robert M. Crawford, W. H. Fulweiler, C. J. Ramsburg, H. A. Brassert, Dr. Horace C. Porter, C. V. McIntire, I. F. Lauks, well-known engineers.

Census Data on Synthetic Organic Chemicals

The annual census of dyes and other synthetic organic chemicals has just been completed by the U. S. Tariff Commission giving figures for the calendar year 1925. This statistical report, which in general follows the form of previous years, includes for the first time this year an estimate of the cost of dyes in representative fabrics and garments.

Iron and Steel Men Discuss Welding and Corrosion

October 22, 1926 was the occasion of the thirtieth general meeting of the American Iron and Steel Institute, at the Hotel Commodore, New York. The usual large attendance heard Judge Gary's annual presidential address, which was followed by an interesting technical program which occupied the whole day. In the evening the annual banquet was held at the Commodore with Judge Gary in the chair and Queen Marie of Rumania as the guest of honor and leading speaker.

Judge Gary's annual optimistic business forecast was preceded this year with a rousing plea for better business relations. The veteran chairman of the United States Steel Corporation took as his text "friendly co-operation," the keynote of the conference between Briand of France and Stresemann of Germany when they met at Thoiry to establish friendly relations between the two countries. Stressing the words of these statesmen, that there should be "no more war," but rather "friendly co-operation," the Judge made a plea for such relations between steel-makers as well as nations, even hinting that the foundations had already been laid for an entente between the European and American steel industries.

The "Corrosion of Structural Steel" was ably discussed in a paper by F. N. Speller, metallurgical engineer of the National Tube Co., who pointed out that steel structures must be adequately protected against corrosion, although the parts of the structure exposed are relatively small. Methods that can be used to this end were detailed and the need for further data upon which to base protective measures was pointed out. The speaker called attention to the service that could be performed by systematic inspection of the steel in structures that are demolished and the rendering of reports on such inspections.

C. A. Adams, American Bureau of Welding, read a paper on the "Welding of Iron and Steel." This paper described and discussed methods of welding, and applications of welding. Of particular interest were the illustrated descriptions of some of the outstanding large welding jobs of recent years, such as the all-welded gas holder at Melbourne, Australia and the 90 mile, 65 in. water pipe-line in California.

Internal Dissension May Disrupt Potash Syndicate

Internal troubles in the German potash industry apparently are serious. Latest information from that country indicates that the Wintershall concern is prepared to withdraw from the producers' combine. It is believed that lower prices are likely even if there is no break in the ranks of the German producers. The Wintershall interests are insisting that the quota of certain high-cost properties be allocated to low-cost producers and the former properties closed. If the Wintershall concern does not withdraw it is expected that important concessions will be made to it, which would mean that a larger proportion of the production would come from the low-cost properties.

A report from W. T. Dougherty, trade commissioner at Berlin, says that the Burbach concern, by suddenly acquiring majority shares of the Gumpel concern has strengthened its position in the German Potash Syndicate, in opposition to the Wintershall concern. Burbach has a syndicate production quota of 9.9 per cent and Gumpel, 7.8 per cent. This will give Burbach a future quota of 17.7 per cent, which with an additional quota to be acquired by the new high percentage sylvinite mines in Baden, to be under production shortly, will give Burbach a quota next year of about 19 per cent in the Syndicate. This percentage quota will thwart efforts of Wintershall to increase its 39 per cent quota and thus get majority syndicate control. The Burbach and Gumpel concerns, with a combined quota of 52.1 per cent in the syndicate, belong to the so-called anti-Wintershall bloc.

Bureau of Standards Will Celebrate Anniversary

A celebration of the twenty-fifth anniversary of the Bureau of Standard of the Department of Commerce is just announced. On Saturday, Dec. 4, the bureau will keep open house and a banquet will be given at which the many friends of the bureau will meet the staff and the achievements of the quarter century will be reviewed, and the present and future work will be discussed. A group of distinguished guests will attend. The event is of interest to the world of science and as well to the industrial experts who have worked so closely in co-operation with the bureau and in turn made application of its discoveries and developments in perfecting the measured control of processes.

Merger of Large Chemical Companies in Great Britain

Amalgamation of Four Leading Concerns Will Center Control of Heavy Chemical and Dyestuffs Manufacture

From Our London Correspondent

ANNOUNCEMENT has just been made of the amalgamation of four leading concerns, Nobel Industries, Brunner Mond & Co., Ltd., the British Dyestuffs Corporation and the United Alkali Co. Rumors of amalgamation between the two last named have been persistent and there has been extensive buying of shares and considerable appreciation of their value. It was generally felt that the original rumor did not disclose the whole story and that it would be illogical, having regard to the organization of corresponding concerns in other countries, such as the German Interessen Gemeinshaft to rest content with a small amalgamation scheme, knowing that the explosives and allied industries would be a vital factor in a well balanced whole. The confirmation of these rumors has been received with mixed feelings because public opinion in this country has an instinctive dislike for trusts and this in spite of the fact that such community of interests as are exemplified by Lever Brothers and Nobel Industries, have in the past not only worked well but have been of direct benefit to the consumer in stabilizing and reducing prices. Brunner Mond are, of course, pioneers in the synthetic ammonia field and the United Alkali Co. having taken an interest in the Casale plant, it looks though there would be no room in the future for anyone else. Both in this field, in the domain of heavy chemicals and in that of dyestuffs, the outlook for the individual inventor is distinctly precarious and it would need to be something of exceptional merit or importance or else an invention which, if worked abroad, would materially cheapen production, before the proposed "British Community of Interests" could be induced to allocate a just reward. Speculation will, of course, be rife both in regard to the shares and as to the probable name of the new company and it will be some time before definite proposals as to exchange of shares are laid before the holders in the individual companies. As regards the British Dyestuffs Corporation, one attraction of bringing this into the fold was probably the availability of works and factories not at present usefully employed, substantial buildings paid for by the taxpayers' money, conveniently linked up with an organization now on its feet under competent management and available at an economic price for the concentration of new manufactures upon which the margin of profit will not be of the nominal character obtaining in the manufacture of dyestuffs. It will be interesting to observe to what extent and how quickly concentration of specified manufactures can be effected in the individual works and the extent to which control, research, buying and selling and information can be centralized.

On the subject of synthetic ammonia, attention might be drawn to a patent just published, No. 257,689, in the names of Blackburn and Thomas, according to which superheated steam is said to be capable of replacing purified hydrogen at low pressures and with yields and conversion efficiencies comparable with those of the Haber and like processes. Further progress is being made in Europe with the development of Vitazote and other fertilizers based on urea compounds, but full development appears to be held up owing to shortage of cyanamide. The I. G. in Germany is reported to be in the position to supply urea in bulk at prices below the market value of nitrogen and new developments are reported in the manufacture of thio-urea. The Salermo process of low temperature carbonization, which has been giving good results in Europe, is now to be introduced in England. A recent development has been the catalytic treatment of the primary tar by the Mony process and installations are contemplated using the semi-coke either in briquetted form or directly as pulverized fuel. Apart from the speculative interest in the shares of the firms concerned in the new merger referred to above, the undertaking of the Nuera Artificial Silk Co. has received considerable prominence during recent weeks. The company was originally formed to take over the Sindl (Austrian) process for viscose silk and Dr. Herbert Levinstein and Julius Huebner, formerly of the Manchester Institute of Technology, were closely connected with the enterprise. Recent reports in regard to the success of the process, which is said to be producing viscose silk of increased tensile strength, have resulted in a spectacular rise in share values and it is also believed that the company has an option on some of the new processes developed in Vienna by Dr. Lilienfeld. The possibility of the control of this company being acquired by Messrs. Courtaulds is not unconnected with the spectacular interest which has been displayed by the public and London financiers and it would not be surprising if, during the next few months, steps were taken to consolidate the rayon position by a merger of such of the many companies which have been floated during the last two years as have proved reasonably successful. It is regarded as unlikely however, that the rayon business will be added to the proposed chemical merger, as has been done under somewhat different circumstances in Germany.

The heavy importations of coal from America, coinciding as they do with grain shipments, have sent up freight rates very materially and have had the unlooked for effect of assisting the shipping industry as regards repairs and particularly the re-commissioning of any vessels at all suitable for this business. The peak of coal production in Germany having been reached and bearing in mind the immediate needs of German home consumption, seasonal and otherwise, exportation from Germany has diminished very considerably and the shortage of transport of all kinds has accentuated this movement. If therefore, the rumours which are current regarding a British embargo on the importation of German coal should prove well founded, its results will for all practical purposes be nil.

Interesting Program for A.I.C.E. Annual Meeting

The nineteenth annual meeting of the American Institute of Chemical Engineers will be held at Birmingham, Ala., and Atlanta, Ga., Dec. 6-9. A very interesting program has been arranged for the various sessions, including the reading of papers on a wide range of topics pertaining to chemical engineering. The meeting will be called to order on Monday morning, Dec. 6, at the auditorium of the Alabama Power Co. in Birmingham. On Wednesday, Dec. 8, the scene of action will be shifted to the Biltmore Hotel, Atlanta. The program includes visits to many industrial plants in Alabama and Georgia. The meeting will close on Thursday evening with a banquet at the Biltmore Hotel. After the banquet a special train will leave for Copperhill, Tenn., where the Tennessee Copper Co. will give an opportunity to visit their mines and ore flotation plant as well as the mammoth sulphuric acid plant.

Government Compromises Picric Acid Claim

The Department of Justice, with the concurrence of the War and Treasury Departments, has compromised for $215,000, a claim growing out of the proposition to establish with government aid a plant for the manufacture of picric acid in Arkansas during the closing days of the war. During 1918 the government advanced to the Everly M. Davis Chemical Corporation the sum of $750,000 for the erection of the plant. The government was to receive certain quantities of the acid manufactured by the plant. Before the contract had been completed the Armistice was signed, and shortly thereafter the Davis company became bankrupt.

This company, with the approval of the war department, had received certain moneys from other corporations for the actual construction of the plant. The concerns advancing this money also became bankrupt. The government was protected for the moneys which had been advanced by the bond of the National Surety Co. The Davis company returned to the government the funds advanced to it, except $220,000 of which $50,000 represented interest. The government looked to the National Surety Co. for reimbursement. A compromise of $215,000 was made by the Surety company which was accepted by the government.

News from Washington

By Paul Wooton
WASHINGTON CORRESPONDENT OF *Chem. & Met.*

AMONG the producers of American chemicals and allied products only one in four is trying seriously to build up an export business. This is the outstanding reason why the chief executives of these industries are being called to Washington, December 6 for a conference with the Secretary of Commerce and his staff.

Secretary Hoover's chemical advisory committee, of which E. Cressy Morrison is chairman, feels that failure of so many concerns to export constitutes an element of weakness which should be overcome. If twenty-five per cent of our chemical production were moving steadily into the foreign trade, it would be an anchor to the windward in case the obsorptive power of the domestic market should be diminished. The committee feels, and Secretary Hoover concurs, that the key men in the industry should discuss the matter. If convinced that increased attention should be paid to the export field, men of this type are in a position to put a program into immediate effect.

While the fact that only six per cent of the country's chemical production is exported is something of a reflection on the industry as a whole, it is true that some companies have distinguished themselves in this regard and are exporting a large proportion of their output. The exporters are not confined to large concerns. Many small producers ship to other countries from ten to fifty per cent of their output. On the other hand. many organization, large and small, are marketing practically their entire production in this country.

The paint industry is cited as one of those having a particularly promising field overseas. The world uses over a billion dollars worth of paint annually of which the U. S. accounts for over 50 per cent of the world's production. The balance is produced by five or six other major producers. Still these minor producers are supplying the bulk of the requirements of the non-producing countries of the world, in fact they control four-fifths of the foreign trade in paints, varnishes and related products which amounts to over $100,000,000 annually. Our manufacturers have annexed but one-fifth of all this foreign trade. The opportunity exists, it is declared, at the Commerce Department, to supply a larger portion of the world's requirements. Only three per cent of our domestic production is exported. If exports were brought up to the six per cent level which has been attained by the Chemical industry as a whole. It would run into large figures. In fact our exports would have to be 9 per cent of our production to be proportional to the relative world production importance of this branch of our industry whereas if the paint industry would export at the same rate as the infant dye industry, for instance, it would supply three-fifths of the foreign trade instead of one-fifth, and some manufacturers are not only enjoying but actually exceeding this quota. The slogan "Save the surface and save all" has been registered in fifty-two countries but that step has not been followed by systematic efforts in some of the countries, at least, to arouse the people to the advantages of greater use of paint.

The buying power of the world is increasing rapidly and the opportunity for entering foreign markets never was better. Great things are expected to result from this meeting, which is to be a one day affair. Secretary Hoover will be the only speaker at the dinner, which will conclude the day's activities.

Tank Car Regulations

Tank car regulations which will be satisfactory to the chemical industry apparently are being worked out. The views of all concerned have been brought to the attention of the Interstate Commerce Commission and to the Bureau of Explosives. A further hearing was held in Washington October 27. The Bureau of Service of the Interstate Commerce Commission has suggested that the specifications, which are to be given the force of law, bear this note:

"This specification is made general in character with respect to equipment for the loading and unloading of tanks and for the discharge therefrom of interior vapor under pressure. Additional restrictions as found necessary will be made effective by further orders of the Commission. Designs of equipment for loading and unloading and for the discharge of vapor must be approved by the Commission before the equipment is applied to tanks used for the transportation of dangerous articles.

"It is understood to be the Commission's attitude, as indicated by correspondence, that the tank specifications must indicate in detail the construction and all the requirements that are essential to safety; that none of the Commission's powers or duties for this purpose may be delegated to the American Railway Association or the Bureau of Explosives."

The plan is to put the regulations into effect on tank cars to be completed after July 1, 1927, but that all equipment put in service before that date is to be approved if complying with the general safety requirements.

Manufacturers of glue in sixteen European countries have formed an international syndicate. The purpose of this combination is to allocate among them the consuming territory, thereby putting an end to the cut-throat form of competition which has existed for several years and to prevent the scramble for raw materials. At present the raw materials from which glue is made are insufficient to meet the demands of all manufacturers. As a result each producer has been bidding against the other.

The syndicate is to be incorporated under Swiss laws. The countries participating in its formation are: Germany, France, England, Italy, Belgium, Holland, Switzerland, Austria, Czechoslovakia, Jugo-Slavia, Hungary, Rumania, Poland, Sweden, Denmark, and the Russian Independent States. The headquarters of the syndicate will be at Geneva.

It is expected that this action will have a bearing on the investigation of glue and edible gelatine by the U. S. Tariff Commission. In the case of edible gelatine all of the field work has been done and the information is being put in finished form. In the glue investigation the foreign field work has just been completed. At present rates of duty large quantities of each of these materials are imported, thereby making it impossible for domestic producers to utilize all of the raw materials that are available.

Means have been found in Germany, reports from that country state, which make it possible to use the local low-grade deposits of phosphate rock. A product to be known as "Leunapho" is to be produced by the I. G. in time for next spring's fertilizer season. An initial production of 60,000 tons of a phosphate-nitrate fertilizer is promised. The nitrogen content is to be twenty per cent, with fifteen per cent P_2O_5.

Another effort is to be made to effect a price and market agreement between the producers of phosphate in Tunis and in Algeria. A former agreement, after having been in effect a few months, was abandoned because of the refusal of Morocco to enter the combination. Because of the competition, the Tunisian producers claim that they are being forced to sell at less than cost of production. Thus, it is contended, a great natural resource is being dissipated without commensurate returns. Special prices are to be made to French importers so that there will not be any hardship worked upon French farmers.

Members of Congress interested in potash exploration think some of the departmental lawyers are in error in interpreting the potash act to require that the government be reimbursed for its exploratory expenditures, even if there is failure to find potash. It was obviously the intent of Congress to provide for reimbursement from royalties only.

The law provides that the contract shall require the owners within a radius of one mile to pay to the government "an amount equal to the actual costs of said explorations." The act provides further, however, that "said payments are to be made at such times, in such manner and in such proportions as the Secretaries, in their discretion, may determine to be equitable." The opinion on Capitol Hill is that this language, particularly when considered in connection with the record of the hearings and the statements made on the floor, justifies the drawing of a contract providing for reimbursement out of any royalties that might accrue to the land owners.

Distinguished Foreign Chemists in Attendance at the Recent Meeting in the United States of the International

Numbered from left to right, the visitors were:
1. Robert L. Mond
2. E. Crespi
3. K. Matsubara
4. M. Breslauer
5. W. Swietoslawski
6. E. Moles
7. C. Fernandez
8. P. Verkade
9. C. Andronescu
10. Ch. Lormand
11. K. Ikeda
12. Justin Dupont
13. F. G. Voerman
14. F. Donker-Duyvis
15. Mme. M. Bakunin
16. P. Van Romburgh
17. A. F. Holleman
18. Marc Bridel
19. A. Ruys

American Gas Association Holds Annual Meeting

President Abell Summarizes Important Problems of Gas Industry

The American Gas Association held its Eighth Annual Convention and Exhibition on the Million-dollar Pier, Atlantic City, N. J., Oct. 11 to 15. About 4,000 members and guests were in attendance. The exhibition covering over 53,000 sq.ft. of space, included booths of approximately 215 exhibiting companies.

The usual group of general and sectional meetings was held and these are reported in *Chem. and Met.* pages of this and succeeding issues. The social features of the convention included various parties for the ladies, the president's reception, the public utilities symposium, at which Anna Case, of the Metropolitan Opera Co. rendered vocal numbers. It was notable that the attendance at all of the technical and business sections was excellent despite the fact that the exhibits were all simultaneously open. In contrast with many other technical shows the exhibits were closed in the evening.

The officers of the association elected for the coming year were: president, A. B. Macbeth, of the Southern California Gas Co., Los Angeles; vice-president Oscar H. Fogg, of the Consolidated Gas Co., New York; and Treasurer, C. E. Paige, of the Brooklyn Union Gas Co., Brooklyn, N. Y. The newly elected officers of the Technical Section of the association are: chairman, Walter C. Beckjord, of the American Light and Traction Co., New York; and vice-chairman, Harry E. Bates, of the Peoples Gas Light and Coke Co., Chicago. The officers of the Industrial Gas Section for the coming year will be: chairman, Henry O. Loebell, of the Combustion Utilities Corporation; and vice-chairman, F. C. Mackey, of the Public Service Co., of Northern Illinois, Chicago.

Reports of the treasurer and the secretary-manager showed that the association affairs were in splendid condition. During the past year expenditures were approximately $350,000; and at the end of the year net assets were approximately $105,000. Membership in all classes increased during the year, but most notably among the manufacturer company members, who make up the group exhibiting at the annual conventions. Statistics presented by Major Alexander Forward, secretary-manager of the association, indicate that the production of manufactured gas during the past year was approximately 16 billion cu.ft. greater than in any preceding year, the total production as estimated was about 460 billion cu.ft. Corresponding increases were noted in the number of customers, the number of miles of main in the distributing systems, and in all other phases of association activity.

In order to meet the increasing responsibilities of the Association a special committee proposed that substantial increases in dues be made for all classes of member companies. A considerable number of changes in the constitution and by-laws of the association were formally approved at the first general session to accomplish this result.

As a part of his retiring presidential address H. C. Abell discussed at length what he deemed the seven most important problem before the industry. The problems as stated by Mr. Abell are:

"1. The use of the best raw material suited for economic manufacture of gas in the territory to be served. 2. The adoption of the best means of generating gas of the quality best suited to serve the territory, including an investigation into the disposition of residuals or a more complete gasification. 3. The best method for economic distribution of gas, with consideration to be given to the development of large gas manufacturing plants and transmission systems. 4. The development of the most economic appliances and their safe use, both for domestic and industrial purposes. 5. Developing and following up domestic uses for gas. 6. Advertising —Everyone appreciates that advertising, in proper kind and amount, must be done because it is absolutely necessary. A properly conceived and developed plan will unquestionably produce the best and the quickest result at the least expenditure. 7. Rates—To promote the adoption of the principles of the three-part rate."

American Engineers Will Build Nitrogen Plant in Norway

The Nitrogen Engineering Corporation of New York City has been awarded a contract to build a nitrogen fixation plant for the Norsk Hydro-Elektrisk Kvaelstofaktieselskab of Christiania, Norway. In securing this contract the Nitrogen Engineering Corporation was brought into competition with the Badische concern, and leading chemical engineers in France, Italy, and Germany. The new plant will be built at Natodden, Norway, and will be the first plant in that country to apply direct synthesis of nitrogen. It is probable that some American equipment will be used especially as concerns high-pressure equipment. The plant will operate under the Haber process and under processes devised and patented by the Nitrogen Engineering Corporation. Building will begin as soon as possible and it is expected that it will be completed in about a year and a half.

Union of Pure and Applied Chemistry, Photographed in Washington, D. C., September 13, 1926.

20. Gabriel Bertrand
21. Ernst Cohen
22. Jean Voisin
23. Paul Sabatier
24. L. Rolla
25. Emile S. Mond
26. Frederick Swarts
27. Umberto Pomilio
28. N. Parravano
29. Colonel Helbig
30. St. Minovici
31. Prince Ginori Conti
32. Francesco Giordani
33. W. Lash Miller
34. J. Annusson
35. L. C. Westman
36. W. D. Treadwell
37. G. S. Whitby
38. Stanislaw Pilat
39. J. N. Bronsted

News in Brief

Robert Kennedy Duncan Memorial Lecture — The 1926 Robert Kennedy Duncan Memorial Lecture was delivered by Lawrence V. Redman, formerly president Redmanol Chemical Products Co., and now director of research of the Bakelite Corporation, in the Fellows' Room of Mellon Institute of Industrial Research, University of Pittsburgh, on Nov. 1. Mr. Redman, who was associated with Dr. Duncan at the University of Kansas, as an Industrial Fellow, 1910-1914, spoke on Dr. Duncan's life, work and aims. On Nov. 2, Mr. Redman again addressed the members of the Institute, speaking on "Why Chemists Should Be Financiers."

Keebra Process Used in Canadian Paper Mill.—The Canada Paper Co. has completed the rebuilding of its soda mill at Windsor Mills, Quebec, which is now equipped to produce pulp by the Keebra process. It is the first mill in Canada to adopt this process. Oliver filters have been installed for washing the stock from the digesters and a new Stebbins bleacher has also been put in.

Chemical Museum at Bucknell—The Department of Chemical Engineering, Bucknell University, Lewisburg, Pa., is arranging for the establishment of a chemical museum at the institution, and expects to start the initial department some time during the present school year. The work is being developed under the direction of Dr. S. G. Osburn, a member of the faculty.

Breaks Record For Tire Production—The Goodyear Tire & Rubber Co., Akron, O., has established a new high production record at its plants during the third quarter of the year, when 3,721,209 tires were manufactured. The record output includes production at the plants at Akron, Los Angeles, Cal., and in Canada, and compares with 3,455,022 tires produced in the second quarter of the year, and 3,493,164, in the first quarter.

Phosphate Rock Found in Ireland—Discovery of phosphate rock in Ireland is reported from the American consulate general in Dublin. The deposit was under the shales in the western part of county Clare and has been traced for a distance of twenty miles due south of Black Head. The description of the deposit comes from the owner who states: The phosphate rock is in three beds which are not of uniform thickness. In some places they are mere bands an inch or two thick. In other places the thickness increases to six feet.

Chemicals and Fertilizer Contribute Large Railroad Tonnage—Fertilizers to the extent of 2,545,867 tons were contributed to the total tonnage handled by the Class One railroads during the second quarter of 1926. Of that total 901,681 tons originated in the eastern district; 1,308.873 tons in the southern district; 238,433 tons in the western district, and 96,880 tons in the Pocahontas region. The figure for chemicals and explosives was 2,457,290 tons. Of that amount 1,676,687 tons originated in the eastern district; 315,989 tons in the southern district; 397,627 tons in the western district, and 66,987 tons in the Pocahontas region.

Pacific Coast Fellowship for Gas Research

Industrial research is being recognized as of greatest importance by the gas industry of the Pacific Coast. This recognition comes not only from the producing companies but also from the men operating the plants.

At a recent meeting of the Pacific Coast Gas Association, it was voted to establish a research fellowship carrying one thousand dollars per annum for three years at the University of California. This fellowship is to be established for the study of problems of interest to the gas industry. The membership of the Association is drawn from manufacturers and users of gas on the Pacific Coast and includes besides many operating companies, employers, employees and many men and women interested in gas.

Expansion of Rayon Industry in Canada

There are increasing evidences that the rayon industry in Canada is on the eve of great expansion. The possibilities for the manufacture of this product in the Dominion, with her vast pulpwood areas are enormous.

In 1922 the Natural Resources Intelligence Service of the Department of Interior published a report drawing attention to the unusually favorable conditions for the development of artificial silk manufacturing in its entirety, within the Dominion. The following year Courtauds, Ltd., largest manufacturers in the United Kingdom, sent engineers to Canada to investigate these representations, with the result that a plant was established in Cornwall, Ontario, at a cost of $2.500,000.

This would appear to be but the preliminary of many others. Canadian Celanese, Ltd., capitalized at $7.000.000, is now constructing a large plant at Drummondville, Quebec, and the Howard Smith Paper Mills have formed a subsidiary company called the Canadian Cellulose Company, which will also be operated in Cornwall.

France Is Substituting Zinc Pigments for White Lead

French Production of Zinc Oxide Already Reaches Large Total and Lithopone Output Will Be Increased

From our Paris Correspondent

CONSUMPTION of white lead in France has been falling off steadily in recent years. This condition practically dates back to the passage of the law which prohibited the use of white lead. The law was to become effective in January, 1915, but the war acted as a stay and the ban on white lead never was put into force. Among consumers, however, the tendency has grown to substitute zinc pigments where white lead formerly was used and judging from present conditions the use of white lead seems destined to become negligible.

The production of zinc oxide has reached about 15,000 tons yearly, for the greater part, the product of the Société de la Vielle Montagne, the Société des Couleurs Zinciques and another plant located in the region of Marseilles.

Developments looking toward an expansion in French production of lithopone are now attracting attention. Before the war consuming demand had reached 10,000 tons annually and the greater part of this was imported. It is true that French plants were about to start production when the war interfered. In 1923 consumption had grown to 15,000 tons per year with the home output able to offer less than one-seventh of this total. Even in 1925 importations of lithopone were approximately 10,500 tons.

This situation is now to be changed. Near Valenciennes the Société des Couleurs Zinciques has rebuilt a plant which had been destroyed during the war. This plant already produces zinc oxide. It will also be able to turn out 20,000 tons of lithopone per year. According to reports this society is allied with the Dutch concern Maastrichtsche Zinkwit Maatschappij, the biggest European producer of lithopone. This group is said to have in view an output of 80,000 tons per year.

It may be of interest to note that the French producers are turning out a so-called normal lithopone. This normal lithopone contains 29.4 per cent of zinc sulphide and 70.6 per cent of barium sulphate. It is also called molecular lithopone being obtained by the double decomposition of zinc sulphate and sulphide of barium, which gives a close and finely divided mixture that is impossible to be separated into its compounds by mechanical means.

Besides the Société des Couleurs Zinciques, which through its Bouchain plant is becoming the largest French producer of lithopone, we may mention the Société des Blancs de Comines at Comines, the Société Générale pour la Fabrication des Couleurs et Produits Chimiques at Saint-André-lez-Lille, the Société des Produits Chimiques of Estrée-Glanche, and Lefrant, Durganol & Co. at Havre.

In previous correspondence we have mentioned the industry of titanium white which is also gaining in use. The cost of this pigment is unfortunately very high because we are obliged to import from Norway the ilmenite necessary for its making. Its use is however profitable by mixing it with barium sulphate; it has also been found that it was advantageous to mix it with zinc oxide in a proportion which can reach 25 per cent.

We have previously referred to the formation of the society Le Kétol which by utilizing the patents of Lefranc, intended to prepare butyric acid starting from saw dust. By hydrolysis of the saw dust, glucose is produced which, submitted to butyric fermentation under determined conditions, gives butyric acid. This production is now on a commercial scale in the Ris-Orangis plant of the Society Le Kétol, near Paris. Actually there is produced pure butyric acid at 100 per cent and industrial acid at 95 per cent. The 100 per cent acid is sold 37 francs per kilog. and the 95 per cent 30 francs per kilog. By distillation of the butyrate of lime is obtained the so-called ketol.

Somewhat fuller information can now be given about Urbain's activated carbon already mentioned in our previous correspondence. This society discloses an increasing business as is shown by the following figures: Production which in 1924 reached 1,200 tons increased to 28,000 tons in 1926. The Société des Charbons actifs Urbain now possesses two plants under operation, one at Nanterre near Paris and another at Givors near Lyons.

The rayon ordinarily spun in France is viscose-silk for which the raw material is imported either from the Scandinavian regions or from Canada. For viscose-silk, pulp is the starting point, of which France produces only small quantities. This entails imports of more than 200,000 tons of chemical pulp every year. The greater part of importations is used for the making of paper, actual production of rayon being only 7,000 tons per year. This latter manufacture requires a pulp of a great regularity and a high pureness. Indeed after soda and carbon bisulphide have acted on cellulose giving a xanthogenate of cellulose, the most ticklish operation in preparing viscose silk consists in its ripening by which the raw material is made fit for spinning. The more consistent the composition of the chemical pulp will be the more regular will be the viscose obtained with it. The Canadian celluloses, as the kipawa, are at present competing keenly with the Scandinavian pulp which formerly was used almost exclusively.

It is stated that the regularity of the pulp is obtained by selecting trees of a same kind and of about the same age. Canada, thanks to its prodigious wood reserves can do this readily while in Sweden and Norway such choice is more difficult. It is very probable that the composition of the cellulose differs with the age of the wood; it seems especially that the proportion of alpha and beta cellulose is in accordance with the ripeness of the wood.

Statistics for the fertilizer trade of 1925 in France have recently been issued. As consumers the country is still behind other countries. This is due to the extreme parcelling of our soil. To give an idea of this division note that on a total number of six million estates, there are hardly 10,000 exceeding a content of 200 hectares.

As producers France is on the way to get the first place in phosphate fertilizers. With Germany it holds the world's market for potash. In superphosphates the production for 1925 was the same as for 1924. This production is a little more than 2 million tons.

Consumption of nitrogen fertilizers in France is increasing steadily, that for 1925 amounting to 611,000 tons representing 107,000 tons of nitrogen. A large part of this consumption still is represented by Chilean nitrate of which 280,000 tons were imported. Other nitrogen fertilizers used in 1925 were 260,000 tons of ammonium sulphate, 62,000 tons of cyanamide, and 15,000 tons of nitrate of lime. French production in 1925 was 117,000 tons of ammonium sulphate, 8,000 tons of which were obtained from synthesis, and 50,000 tons of cyanamide.

The following table shows the position of the synthetic nitrogen industry in France:

Plants Under Operation

Georges Claude process

Number of Plants	Production in Nitrogen Tons — Monthly — Actual	Monthly — Prospective	Yearly — Foreseen
4	410	1.320	15.850
	Plants under construction (which are to be put under operation in 1926-1927)		
	Georges Claude process		
1	...	300	3.600
	Casale process		
8	...	5.700	68.400
13	...	7.320	87.850

In potash salts France enjoys complete independence. In 1925 it produced in raw potash 1,926,346 tons against 1,664,000 tons in 1924. Home consumption has reached 448,173 tons of divers salts while exports were only 571,543 tons, an apparent decrease since 1923. In reality exports, translated in pure potash have increased, rising from 55.675 tons of pure potash in 1923 to 203,155 tons in 1925.

Sale of Marx and Rawolle Glycerine Plant

Announcement was made in the latter part of October of the sale of the glycerine refining plant of Marx & Rawolle, Inc., of New York to the Consolidated Products Co. Following the sale a new corporation was formed and is known as the Marx & Rawolle Corporation. The new concern is continuing the business as heretofore. The Consolidated Products Co. is engaged in liquidating industrial plants. It plans to offer for sale the plant and business of the Marx & Rawolle Corporation. The business of Marx & Rawolle, Inc., was established more than fifty years ago and the company has held a prominent place among the glycerine refiners of the country.

Men You Should Know About

C. R. DeLONG has resigned as chief of the Chemical Division of the Tariff Commission, effective Nov. 30, to become head of the commercial research department of the Federal Phosphorus Co., with headquarters in Birmingham, Ala. The company has thus far confined itself to producing and marketing phosphoric acid, having developed along commercial lines the government's electro-thermal process of manufacturing phosphorus. W. N. Watson, color specialist of the Commission's Chemical Division, will become acting chief until a permanent appointment is made.

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C. R. DeLong

Mr. DeLong joined the Tariff Commission's staff in 1918 and three years later was made chief of the Chemical Division.

Col. FREDERICK POPE has just returned from Norway where he completed negotiations with Norsk Hydro Elektrisk Kvaelstofaktieselskab of Christiania for the design and construction of a nitrogen fixation plant by the Nitrogen Engineering Corporation, New York City.

P. H. GROGGINS, formerly with the Monsanto Chemical Co., St. Louis, Mo., is now on the staff at the Color Laboratory, Washington, D. C., as associate chemist.

W. H. WAGGAMAN, who has been engaged on phosphoric acid development work for several years with the Victor Chemical Co. of Chicago, has terminated this work and is again in charge of phosphoric acid investigation of the Bureau of Soils, Department of Agriculture, Washington, D. C.

J. H. WAGGONER, of Charleston, W. Va., has become a member of the staff at the Mellon Institute, Pittsburgh, Pa.

A. E. CARVER has resigned as research chemist for the Grasselli Chemical Co., Cleveland, Ohio, to accept a position with Weiss & Downs, of New York.

B. S. CLARK, of San Francisco, Calif., has been appointed director of the research laboratory in that city recently established by the National Canners' Association.

MAX Y. SEATON, chemical engineer, heretofore connected with the California Chemical Corporation, Chula Vista, Cal., has become a member of the technical staff of the Sierra Magnesite Co., Porterville, Cal.

ROBERT G. WULFF, who has been with the Purox Company in the development of reducing and regulating valves for gas cylinders, is now associated with Kobe, Inc., at 1917 East 51st St., Los Angeles, Calif., in chemical engineering research.

Dr. JOHN E. TEEPLE, consulting engineer of New York and treasurer of the American Chemical Society, will receive the Perkin medal, which is awarded annually to the American chemist who has most distinguished himself by his services to applied chemistry, at a public meeting to be he'd in Rumford Hall, Chemists' Club, Jan. 14, 1927.

Dr. S. KARRER is now in charge of the newly organized research department of The Consolidated Gas, Electric Light and Power Company, of Baltimore, Md. This department is taking up the fundamental physical problems of gas utilization and gas flame phenomena. Dr. Karrer left his position as chief of the physics division of the Fixed Nitrogen Research Laboratory to take up this new work.

J. F. T. BERLINER has been transferred from the carbohydrate laboratory of the Bureau of Chemistry to the non-metallics section of the U. S. Bureau of Mines. He will be engaged in research work connected with potash explorations, with official station at New Brunswick, N. J.

C. O. FAIRCHILD resigned from his position as phvsicist in the Bureau of Standards on October 1 to take charge of the new research laboratory and development division of C. J. Tagliabue Manufacturing Co., Brooklyn, N. Y. This division will give special attention to the development of pyrometric apparatus.

C. F. GRAFF, president and general manager of the American Nitrogen Products Co., Seattle, Wash., has been in New York for a few weeks.

ROBERT J. ANDERSON, Inc., Cincinnati, Ohio, chemists, metallurgists and consulting engineers, announce the opening of new commercial testing laboratories.

D. H. JACKSON, formerly with the Elliott Co., is now with the Chemical Catalog Company, Inc., New York.

GEORGE HENRI FELIX CALINGAERT, research chemist of the Ethyl Gasoline Corp., Yonkers, N. Y., was married Oct. 15, to Dorothy Farber.

GEORGE A. SACKETT, formerly chemist and chemical engineer for the Mt. Hope Finishing Co., is now on the engineering staff of the Goodyear Tire & Rubber Co., at their plant in Akron, working on development problems.

O. S. SLEEPER has joined the H. G. Trout Co. organization, Buffalo, N. Y., as head of the engineering department in charge of design and construction of vacuum drying equipment and chemical machinery in general.

W. A. NEILL, chief mechanical engineer of the Dorr Co., sailed for Europe Oct. 23, on business connected with the interests of the affiliated English, French and German companies.

M. I. DORFAN has joined the Pangborn Corporation, Hagerstown, Md., as engineer of the dust collecting department.

EDWARD WESTON, president of the Weston Electrical Instrument Corp., was presented with honorary membership in the American Electrochemical

Edward Weston

Society at its meeting in Washington, D. C., October 8, in recognition of his many services in the field of science and industry represented by that organization.

Dr. COLIN G. FINK, of Columbia University, spoke before the Society of Automotive Engineers, Detroit, Oct. 21, on "Chromium—A Metal of Many Uses."

LLOYD C. COOLEY, formerly chemical engineer with the U. S. Industrial Alcohol Co. and at one time connected with E. B. Badger and Sons of Boston, has returned to the latter company for sales and operating work in the Mid-Continent petroleum industry.

Col. H. A. METZ on October 22 completed 45 years of continuous service in the chemical industry and on this occasion his associates tendered a testimonial dinner in his honor at the University Club, New York.

W. H. SWANSON of the pulp and paper staff of the U. S. Forest Products Laboratory has resigned to accept a position on the research staff of the Champion Fibre Company, of Canton, N. C.

D. W. WILSON has resigned from his position as chemical engineer of the Iroquois Gas Company, Buffalo, and is now associated with the Wilputte Coke Oven Corp., New York.

Prof. G. A. ROUSH, formerly of Lehigh University, is now professor of metallurgy in the State School of Mines, Butte, Montana.

Dr. J. H. SIMONS, who has been head of the chemistry department at the University of Porto Rico, has joined the staff of the chemistry department at Northwestern University, where he will continue his researches in physical chemistry.

R. S. SCHOLL, formerly chief chemist of the Niagara Falls mill of the Kimberly-Clark Paper Co., is now chemical engineer and assistant to the sulphite inspector of the International Paper Co., New York City. Mr. Scholl will travel visiting the sulphite mills of the company.

MARK LINTZ has resigned as engineer for the "39 Mine" at Terlingua, Texas, to accept a position as chemical designer with the American Potash and Chemical Corp. of Trona, Calif.

Dr. JOHN JOHNSTON, head of the Department of Chemistry of Yale University and consultant to the Bell Telephone Laboratories, has just returned from an extensive trip over the Pacific Coast where he has investigated the corrosion of cable sheathing.

Dr. ROBERT M. BURNS of the research staff of the Bell Telephone Laboratories located in New York City, is spending a few months on the Pacific Coast investigating the corrosion of cable sheathing. His address is care of Chief Engineer, Pacific Telephone and Telegraph Co., San Francisco, Calif.

WALLACE P. COHOE, consulting chemist and engineer has moved his office from 290 Broadway to 141 Broadway, New York.

Dr. CARL G. SCHLUEDERBERG has been appointed general manager of the George Cutter Co., South Bend, Ind., a subsidiary of the Westinghouse Electric and Manufacturing Co.

M. C. MOLSTAD has resigned from the chemical staff of the Fixed Nitrogen Research Laboratory to accept a position on the faculty of the Department of Chemical Engineering, Yale University.

R. D. COOKE, formerly with the Columbian Enameling and Stamping Co., is now with the Benjamin Electric & Mfg. Co. of Des Plaines, Ill., where he will establish and direct a new research department to study enameling problems.

WILLIAM N. PRITCHARD, Jr., has joined the research staff of the Federal Phosphorus Co. at Anniston, Ala.

WAYNE H. CARTER, formerly with the Monsanto Chemical Works, is now chief chemist of the Sharples Solvents Corp., at Charleston, W. Va.

WILLIAM HUTTON BLAUVELT, consulting engineer of New York, returned on Sept. 12 from Europe, where he made a survey of the by-product coking industries of Great Britain, Holland, France and Germany. Mr. Blauvelt also investigated the newest developments in these countries in low temperature distillation of coal and hydrogenation processes.

I. EDMUND WAECHTER has resigned as metallurgical engineer of the General Chemical Co. to establish himself as a consulting metallurgical and chemical engineer with headquarters in Tampa, Florida.

L. H. ALMY has resigned his position with the U. S. Bureau of Chemistry to become research chemist of the H. J. Heinz Company, at its Pittsburgh headquarters.

C. H. PENNING has resigned from the Chemical Division of the U. S. Tariff Commission, effective Jan. 1, 1927, at which time he takes up his work as assistant technical editor with the Chemical Catalog Company of New York City.

Dr. CHARLES H. HERTY has resigned the presidency of the Synthetic Organic Chemical Manufacturers Association of the United States to assume the duties of advisor to the Chemical Foundation, Inc., New York.

Obituary

AUGUSTE J. ROSSI, consulting chemist of the Titanium Alloy Manufacturing Co. and the Titanium Pigment Company, Inc., died on Sept. 19 following a three-day illness. Dr. Rossi was the inventor of the process for the manufacture of titanium alloy and pigment and was an internationally known chemist. He received the Perkin medal in 1918. Born in Paris in 1838, Dr. Rossi received his education there and at the age of twenty came to New York. Dr. Rossi is survived by his sister and three daughters.

GEORGE K. ELLIOTT, chief chemist and metallurgist of The Lunkenheimer Co., Cincinnati, Ohio, died at Christ Hospital, Cincinnati, Sept. 23, following an operation. He was born at Sidney, Ohio, in 1881. He graduated from the University of Cincinnati and taught science for a while before entering the employ of The Lunkenheimer Co. Mr. Elliott is responsible for the development of the duplex process for cast iron which involves the use in tandem of the cupola and the electric furnace. He described for the American Foundrymen's Association in a number of papers, the metallurgy of cast iron in the electric furnace. He also contributed a number of articles to scientific journals in America and Europe. He is survived by his widow, Mrs. Helen Greenwood Elliott; his mother, Mrs. Charles A. Elliott and a sister, Mrs. H. F. Koenig.

Calendar

AMERICAN CHEMICAL SOCIETY, Richmond, Va., April 12-16, 1927.

AMERICAN ENGINEERING COUNCIL, annual meeting, Washington, D. C., Jan. 13 to 15, 1927.

AMERICAN INSTITUTE OF CHEMICAL ENGRS., Atlanta, Ga., and Birmingham, Ala., Dec. 6 to 10.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York, Dec. 6 to 9.

AMERICAN WELDING SOCIETY, Fall meeting, Buffalo, Nov. 17, 18 and 19.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING (5th) Grand Central Palace, New York, Dec. 6 to 11.

SESQUI-CENTENNIAL INTERNATIONAL EXPOSITION, Independence Sq., Philadelphia, Pa., June 1 to Dec. 1.

MERVILLE SPOOR THOMPSON, chairman of the South Jersey Section of the American Chemical Society, died suddenly Sept. 1, following an operation.

WILLIAM D. LIVERMORE, chief chemist of the American Woolen Co. since 1899, died at his home in Lawrence, Mass., following an illness of several months' duration.

ALEXANDER F. PHILLIPS of Windsor, Vt., a prominent retired manufacturing chemist, died recently at his local residence, aged 77 years.

HENRY HENSLEY EASTMAN, secretary and treasurer of the Hercules Powder Co., Wilmington, Del., died Oct. 8, in the Delaware Hospital in that city from acute dilation of the heart, caused by the swallowing of a chicken bone.

GEORGE MERCK, founder and chairman of the board of directors of the Merck Chemical Laboratories, Rahway, N. J., died at his home at West Orange, Oct. 21, after a week's illness, aged 60 years. He was born in Germany and came to the United States when he was 25 years of age.

Industrial Notes

THE TIMKEN ROLLER BEARING CO. announces the appointment of R. C. Brower as general manager of The Timken Roller Bearing Service and Sales Co., with headquarters at Canton, Ohio.

THE CARBORUNDUM COMPANY, Niagara Falls, N. Y., through its Refractory Division, at Perth Amboy, announces that it has been licensed to sell the Fitch recuperator, and that W. H. Fitch, formerly manager of the metallurgical department of the Fuller-Lehigh Co., is now associated with The Carborundum Co.

THE HARDINGE CO. announces that its Salt Lake City office is now located in the Continental Bank Bldg., 200 S. Main St.

THE LINK-BELT CO. announces that its Boston office is located now at 1103 Statler Bldg. A new branch office has been opened in Utica, N. Y., at 107 Foster Bldg.

FOOTE BROS. GEAR AND MACHINE CO., Chicago, Ill., announces the appointment of J. M. Allen as manager of production.

THE CHICAGO PNEUMATIC TOOL CO. has opened its new building located in the central manufacturing district on Iron Street, near Thirty-seventh Street, Chicago, which is the home of the Chicago sales and service branch. A service branch has also been established at El Paso, Texas, in the Mills Bldg.

THE ALLIS-CHALMERS MANUFACTURING CO., Milwaukee, Wis., announces the appointment of Ernest Smith as sales engineer in the Oruro, Bolivia office. This is a branch of the company's district office at Santiago, Chile. This company is also opening a branch office in Jackson, Michigan, located at 512 Reynolds Bldg.

Market Conditions and Price Trends

Domestic Production of Coal-Tar Dyes Increased in 1925

More Than 90 per Cent of Dyes Consumed in This Country Were Produced Here

THE OUTPUT of coal-tar dyes by 75 firms was 86,345,438 lb. in 1925, as compared with 68,679,000 lb. in 1924. The total sales in the two years were 79,303,451 lb., valued at $37,468,332, and 64,961,433 lb. valued at $35,012,400, respectively. The increased production is in part due to the improvement of the export trade of which indigo and sulphur black are the principal items. More than 90 per cent of the total quantity of dyes consumed in the United States in 1925 were of domestic manufacture, and certain of the lower-priced colors were exported in significant amounts. The progress of the industry during that year is manifest not only in increased output, but in the production for the first time in the United States of many vat dyes, direct developed dyes, alizarin derivatives, and special colors for dyeing rayon and certain mixed fibers. This information is contained in the ninth annual census of dyes published by the U. S. Tariff Commission.

Lower Average Prices

The weighted average price of all domestic dyes sold was about 13 per cent less in 1925 than in 1924. The price in 1925 was 47c. per lb., as compared with 54c. in 1924 and $1.26 in 1917. Price recessions in 1925 were general, occurring in the low as well as the high-priced dyes. They were largely due to the severe competition between the domestic manufacturers, and in the high-priced colors to increased competition from imported dyes.

Seventy-five firms reported production of dyes in 1925, six of which made only bacteriological stains and indicators. In 1924, 78 firms reported, and in 1919, 90 firms. By the end of 1925, four firms had ceased production and one was taken over by another firm, leaving 64 manufacturers of dyes exclusively. The severe competition resulting from excess capacity to produce will, in the long run, eliminate many of the existing firms. It is likely that some of the smaller ones will be absorbed by the larger, and that several others will amalgamate in order to lower manufacturing costs by a reduction of selling expenses, duplication, and overhead.

The number of dye producers in the United States affords an interesting contrast to the situation in Germany and Switzerland. In Germany six firms have been taken over by the Badische, now known as the I. G., leaving two other large producers and perhaps four of minor importance. In Switzerland, three of the four producers have a close affiliation of interest.

Vat dyes other than indigo recorded a peak production, with a total of over 2,600,000 lb, or an increase of 43 per cent over the 1924 figure. The total output of vat dyes including indigo was 31,730,000 lbs. as compared with 21,818,000 lbs. in 1924. The marked annual increase in the consumption of vat dyes is in response to the insistence of the ultimate consumers of textiles for fast-dyed fabrics. Trade-marked fabrics with a color guarantee are becoming an important item in the trade and insure the consumer of a fabric attaining a standard of fastness. Vat colors have been very largely used on cotton; especially on fabrics subjected to the treatment of the modern laundry. The application on silk, however, is assuming more importance each year.

Gain in Imports

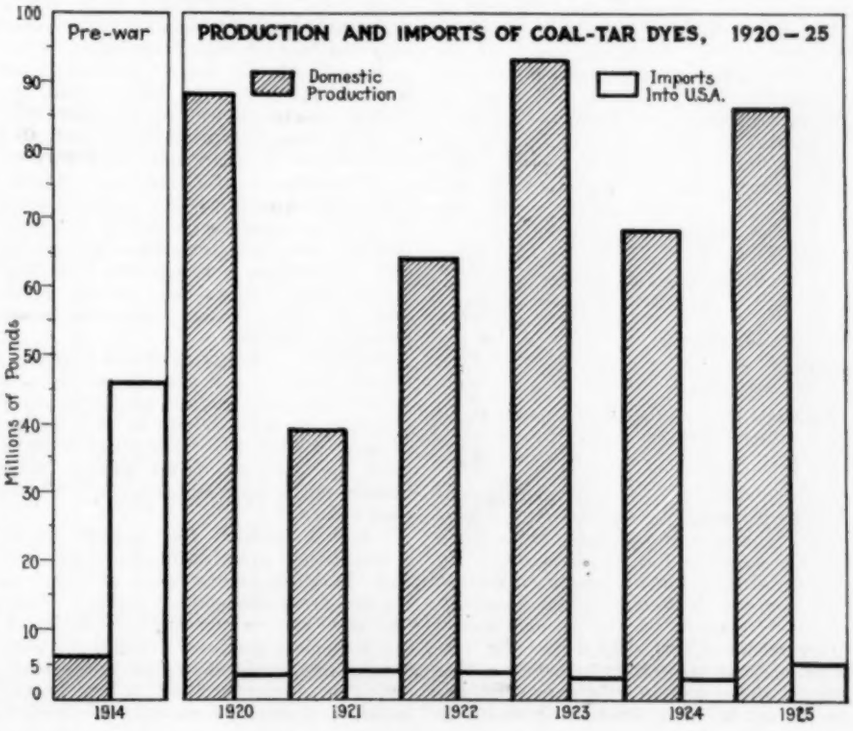
The total imports of coal-tar dyes for 1925 were 5,209,601 lb. valued at $4,637,240, representing a 72 per cent increase by quantity and a 59 per cent increase by value over the 1924 figure. Germany furnished 52 per cent of the imports and Switzerland, 32 per cent, the remainder originating from other countries. Competition from imported colors, principally the high-cost types, has been pronounced. These consist largely of vat dyes, alizarines, developed direct dyes, and dyes covered by foreign patents. This competition has increased since the tariff reduction of 15 per cent on September 22, 1924.

Production and Exports

The following figures show the totals for domestic production of coal-tar dyes and also a comparison of the export and import trade. Prior to 1922 export statistics were confined to values with no reference to quantities.

	Domestic Production Lb.	Imports Lb.	Exports Lb.
1925	86,345,438	5,209,601	25,779,889
1924	68,679,000	3,022,539	15,713,091
1923	93,667,524	3,098,193	17,924,200
1922	64,632,187	3,982,631	8,344,187
1921	39,008,690	4,252,911	.....
1920	88,263,776	3,402,582	.....
1914	6,619,729	45,950,895	.....

Exports in 1925 totaled 25,799,889 lb. valued at $6,694,360, an increase of 64 per cent in quantity and only 19 per cent in value over 1924. Indigo and sulphur black were the leading dyes exported. Some direct dyes and a limited quantity of other types were sold abroad. Severe competition in the world markets has resulted in price reductions in nearly every important consuming country.



Market Conditions and Price Trends

Production of Chemicals Maintained at High Levels

Prospects Favor Decline in Consumption of Fertilizer Chemicals in Coming Season Following Reduction in Cotton Acreage

REPORTS of steady contract buying in recent weeks have borne out statements to the effect that production of chemicals was being continued on a large basis. Improvement also has been noted in some of the principal consuming industries and in most cases production and consumption of chemicals are regarded as being in close relationship. A few exceptions are found as the supply of ammonia seems to be in excess of consuming needs and some producers of ammonia are said to have curtailed manufacturing operations not only to prevent larger accumulations of stocks but also because current selling prices were not regarded as attractive.

With regard to the present state of industry the National Industrial conference Board states that present business conditions are sound, and indications are that industrial and commercial activity on the whole will continue at a satisfactory momentum as far as the immediate future is concerned. This statement represents the composite judgment of leading industrial and financial executives of the country, on the basis of October reports, obtained in conferences on the business outlook.

The latest available survey of the Bureau of Labor covers the status of employment throughout September. An analysis of this report leads to the conclusion that both production and consumption of chemicals was larger in that month than in August and in September, 1925. Without exception the index of employment in the industries, which are the principal consumers of chemicals, was at a higher level than in August and with the exception of the textile and tire industries, the index was higher than in Septembr of last year. The accompanying table sets forth the indexes of employment with comparisons.

INDEX OF EMPLOYMENT

	Sept. 1926	Aug. 1926	Sept. 1925
Dyeing and finishing textiles	96.0	94.2	96.9
Leather	92.3	90.7	90.1
Paper and pulp	95.9	95.2	92.7
Chemicals	95.9	93.6	93.4
Fertilizers	108.6	82.6	105.8
Petroleum refining	102.7	101.6	98.9
Glass	100.5	95.9	93.3
Automobile tires	114.9	111.1	118.0

The prospects for consumption of fertilizer chemicals in the coming season are, perhaps, less favorable than those for the general list of chemicals. By far the largest outlet for fertilizers in this country is found in the Southern states. Because of the record cotton crop produced last season and the consequent low prices in effect for this staple, the cotton planters are not expected to be in a financial position to buy fertilizer up to the standard of last season. Furthermore the attempts to help the present situation by withholding a part of the present crop from the market are predicated in a forced curtailment of cotton acreage next season. This would logically mean a smaller demand for sulphuric acid, nitrate of soda, sulphate of ammonia, potash salts, and other fertilizer raw materials. Hence the large cotton crop is regarded as a depressing factor on that branch of the chemical industry which is affiliated with the fertilizer trade.

Tire Production Smaller

Production of automobile tires in September fell off from the peak reached in the preceding month. This was noted in the case of some of the large plants where a 5-day week was inaugurated at least temporarily in order to check the piling up of stocks. In the Akron district tire production for that month was reported to have fallen 15 per cent below the August total. Manufacturers still hold large stocks which have an influence on the extent of plant operations.

The window glass industry has made considerable progress since the opening of plants at the close of the hot weather period. Plate glass production especially has been encouraging with a total production of 100,622,477 sq.ft. which represents an increase of 15.5 per cent over the corresponding period of 1925.

Manufacturing output in September was only 1 per cent lower than the record output shown for the month of August and was almost 10 per cent higher than a year ago, according to the Department of Commerce. All industry groups showed increased output over a year ago except lumber and nonferrous metals. Raw material output and marketings were slightly less than a year ago; mineral and animal products increased while crops and forest products declined.

Commodity stocks at the end of September were 7 per cent lower than a month previous, after adjustment or seasonal variations, due to the decline in raw foodstuffs. Compared with a year ago, stocks of all groups were higher except raw materials other than foodstuffs.

Unfilled orders for manufactured commodities, principally iron and steel and building materials, showed no change from the end of August. Iron and steel orders increased, while building materials declined. Compared with a year ago, unfilled orders were lower, owing to lower unfilled orders in the building material industry.

The price movement in the market for chemicals has shown no decided trend during the month. Important basic chemicals have been maintained at previously quoted levels and in most cases the new contract prices, effective for 1927 deliveries, are at the same figures as ruled on 1926 business. Competition among sellers and large unsold stocks are reported for a few selections and largely under the influence of these the weighted index number for chemicals declined slightly during the month. The index number now stands at 114.13 which compares with 114.17 a month ago and 112.77 a year ago.

The price trend in the market for vegetable oils and fats is still downward. The most influential factor in the decline is found in the market for cottonseed oil. Here the law of supply and demand is affecting values and the potential supply from the present crop of seed is considerably in excess of any consuming standards yet attained. Unless the low prices divert large amounts to the soap kettle and to foreign markets, the weight of offerings may be felt throughout the crop year. The weighted index number for oils and fats is 133.76 as compared with 135.71 a month ago and 155.69 a year ago.

Foreign Trade Increase

Imports and exports of chemicals during the first nine months of 1926 changed very little from the corresponding period of 1925, exports aggregating $132,118,000, and imports, $161,496,000, says Department of Commerce. Both figures were in excess of those for the corresponding period of 1925, the exports by 6 per cent, and the imports by one-half per cent. Total imports for the first nine months of 1926, 1925, and 1923 were practically the same, but the relative positions of the several groups altered considerably.

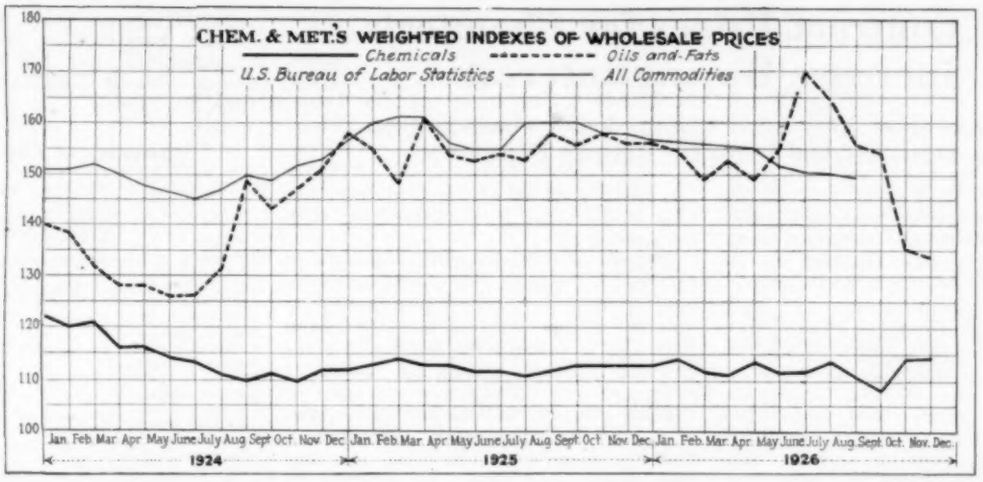
In contrast to the imports, exports have shown a rather steady progress from 1923 with none of the decided changes which were evident in the imports. Though imports of industrial chemicals showed a much larger gain than exports (29 per cent and 8 per cent respectively), they were nearly $2,000,000 less than exports. The increase in imports was fairly well distributed over a number of items, although the big ones made in iodine and glycerin did more to bring the total up to its present figure than any of the others. In exports there were the usual small increases and decreases in the different groups.

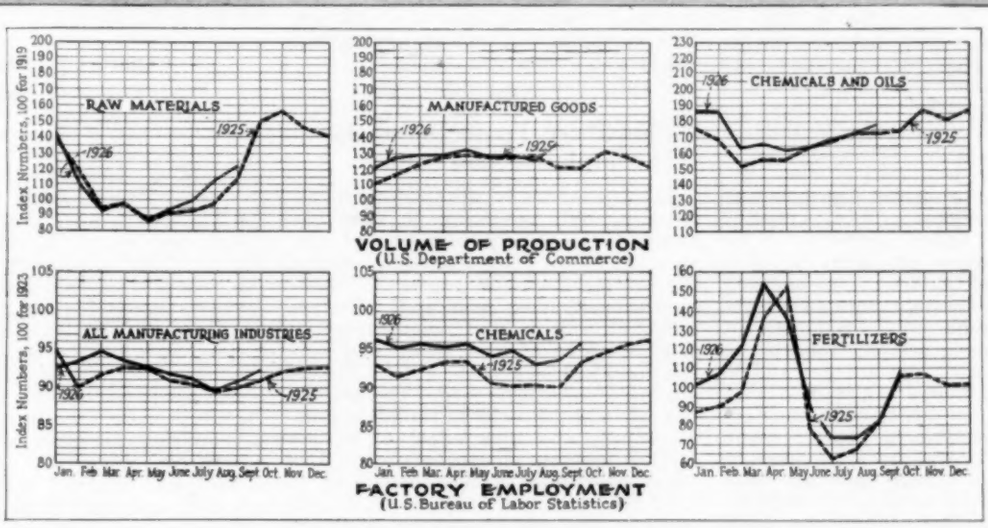
One of the most significant losses in imports was in sodium nitrate, one-fifth less entering the country the current nine months than in the first nine months of 1925.

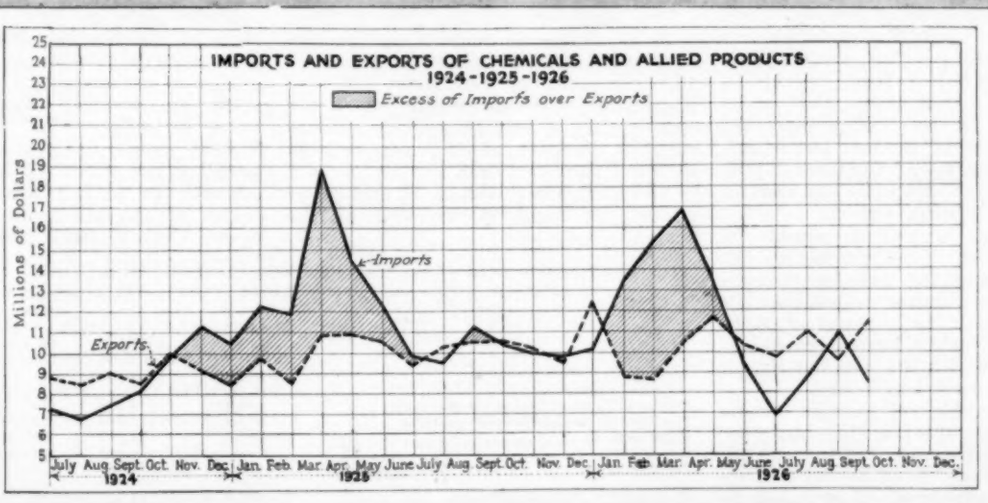
Imports showed notable increases in industrial chemicals and paints and pigments, and decreases in fertilizers and Chinawood oil. Naval stores, gums, and resins, the leading raw materials group and accounting for a fair proportion of the total trade.

CHEM·&·MET· Statistics of Business

In the Chemical Engineering Industries







Market Conditions and Price Trends

New Contract Prices for Chemicals Increase Buying Interest

Quotations Show Very Little Change From Those in Effect This Year—Higher Prices for German Potash Salts

ANNOUNCEMENT of contract prices for 1927 deliveries have been made by manufacturers of various heavy chemicals. This has resulted in an active buying movement and contract placements are reported to have reached a large tonnage. Some producers of caustic soda and soda ash are quoting forward positions at the same figures as applied on 1926 contracts. Other manufacturers have issued no general quotations for these chemicals but have been booking orders. According to reports there has been considerable competition on the part of sellers and quoted prices do not appear to be as well maintained as they were a year ago. Competitive selling in caustic soda and soda ash, as far as the domestic trade is concerned, has not been prominent in recent years, and the present situation has resulted in an open market which has worked to the advantage of consumers.

Considerable competition also has been noted in the market for aqua and anhydrous ammonia. The ammonia market was under pressure some months ago when producers of synthetic material entered the industry and came into competition with the established producers. Producers of synthetic ammonia are now reported to be competing with one another and in some cases producers are said to have curtailed their output because they did not find it profitable to take on quantity orders at prevailing price levels.

Consumers of potash salts are finding a higher price schedule in effect for German goods. The advance was made in spite of reports that prominent factors in the potash syndicate have been advocating lower prices in order to stimulate consumption of potash. Even yet rumors are heard that potash prices will be lowered or that certain producers will withdraw from the syndicate. The increased prices will hardly be regarded as an inducement for domestic makers to increase the potash content of their mixed fertilizers, production of which promises to show a decline in the coming season.

Demand for commercial grades of alcohol has been of an increasing nature and buying for anti-freeze purposes has been a factor in swelling the volume of sales. As a result of more active trading, prices have been firmer and later deliveries are commanding a premium over spot and nearby.

In the vegetable oil market, conditions have been upset by the large indicated production of cottonseed oil. The output of seed is of record proportions and the supply of oil promises to exceed consuming requirements. In consequence values have been dropping steadily and this has been reflected in the position of other vegetable oils and fats which come into competition with cottonseed oil.

Outside of the competition previously referred to, prices for chemicals have held a steady course throughout the month. Minor changes have not been sufficient to disturb the weighted index and the number stands at 114.13 as compared with 114.17 a month ago.

Price changes in oils and fats, however, have been numerous. Strength in linseed, china wood, and fish oils has been more than offset by declines in cottonseed, palm, corn, and peanut oils, to which may be added downward revisions in tallow and greases. The weighted index number for oils and fats is 133.76. A month ago it was 135.71 and a year ago 155.69.

Fertilizer Trade Decreases Sulphuric Acid Output

The Department of Commerce announces that, according to data collected at its recent semi-annual canvass, fertilizer manufacturers during the first half of 1926 produced 935,433 tons of sulphuric acid and consumed 1,085,877 tons in the manufacture of 1,993,363 tons of acid phosphates containing 33,558,000 units (of 20 lb.) of available phosphoric acid. The production of sulphuric acid by fertilizer manufacturers was thus equal to 86 per cent of their total consumption. Acid phosphates sold as such amounted to 1,365,295 tons, containing 22,740,000 units of available phosphoric acid; and 1,201,593 tons of acid phosphates, containing 19,652,000 units, were consumed in the manufacture of other fertilizers.

The statistics for the first half of 1926 as compared with those for the first half of 1925 show increases of 10.7 per cent in production of acid phosphates and nine-tenths of 1 per cent in that of acid phosphates sold as such; a decrease of 16.6 per cent in stocks of sulphuric acid, and an increase of 40.7 per cent in stocks of acid phosphates, on hand at the end of the period.

The following table shows the production, consumption, sales, and stocks of sulphuric acid for the three six-month periods from Jan. 1, 1925, to June 30, 1926:

THE FERTILIZER INDUSTRY—PRODUCTION, CONSUMPTION, SALES, AND STOCKS OF SULPHURIC ACID: 6-MONTH PERIODS, JAN. 1, 1925, TO JUNE 30, 1926.

	1926 1st Half Jan.–June	1925 2nd Half July–Dec.	1925 1st Half Jan.–June	Per Cent of Increase 1st Half 1925 to 1st Half 1926
	Tons			
United States				
Stocks on hand at beginning of period	101,416	104,376	108,586	— 6.6
Produced in establishments reporting	935,433	955,084	855,338	9.4
Purchased (2)	378,415	435,210	330,219	14.6
Total	1,415,264	1,494,670	1,294,143	9.4
Consumed in making fertilizers	1,085,877	1,122,025	971,984	11.7
Sales:				
To fertilizer works	151,232	181,368	128,700	17.5
To other than fertilizer works	94,761	90,815	93,473	1.4
Stocks on hand at end of period	83,394	100,462	99,986	—16.6

Imports of Chemicals

	September, 1926	September, 1925
Dead or creosote oils, gal	3,678,136	12,060,742
Pyridine, lb	36,885	123,320
Arsenic, lb	468,129	1,315,005
Acid, citric, lb	12,320	33,600
Acid, formic, lb	178,773	134,057
Acid, oxalic, lb	102,995	187,905
Acid, sulphuric, lb	3,031,983	2,371,407
Acid, tartaric, lb	133,827	343,360
Ammonia chloride, lb	1,417,957	1,179,189
Ammonia nitrate, lb	968,441	1,058,736
Barium compounds, lb	720,791	2,241,573
Calcium carbide, lb	510,000	1,559,500
Copper sulphate, lb	184,625	224,000
Bleaching powder, lb	328,643	253,893
Potassium cyanide, lb		98,148
Potassium carbonate, lb	794,631	330,431
Potassium hydroxide, lb	764,015	1,124,851
Potassium chlorate, lb	1,152,096	791,263
Sodium cyanide, lb	2,491,172	2,128,231
Sodium ferrocyanide, lb	55,587	79,614
Sodium nitrite, lb	44,877	22,464
Sodium nitrate, ton	37,096	56,762
Sulphate of ammonia, ton	920	253

Exports of Chemicals

	September, 1926	September, 1925
Benzol, lb	18,167,243	7,506,071
Aniline oil and salt, lb	53,521	11,666
Acid, acetic, lb	34,856	45,674
Acid, boric, lb	274,518	58,333
Acid, sulphuric, lb	384,061	478,168
Methanol, gal	38,779	15,320
Aluminum sulphate, lb	3,974,465	3,344,974
Acetate of lime, lb	1,392,453	1,340,490
Calcium carbide, lb	522,712	257,874
Bleaching powder, lb	1,591,418	1,352,372
Copper sulphate, lb	374,904	240,388
Formaldehyde, lb	220,063	118,877
Potassium bichromate, lb	4,791	40,662
Sodium bichromate, lb	566,684	387,005
Sodium cyanide, lb	72,944	149,205
Borax, lb	2,001,479	2,792,056
Soda ash, lb	4,591,061	2,413,122
Sodium silicate, lb	4,326,155	2,716,348
Sal soda, lb	901,883	1,053,688
Caustic soda, lb	8,558,072	6,378,164
Sulphate of ammonia, ton	28,005	14,413
Sulphur, ton	40,011	64,097

Higher Prices Named for German Potash Salts

Under date of Oct. 28, representatives of the German Potash Syndicate announced a revision in prices for all grades of potash salts. The new prices show an advance over those which were in effect this year. Higher freight rates and increased cost of handling are given as reasons for the advance in selling prices. The new prices are to apply on orders placed up to Dec. 1, 1926, calling for Nov.-

Market Conditions and Price Trends

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	**114.13**
Last month	114.17
November, 1925	112.77
November, 1924	111.86

With basic chemicals holding a steady position, changes in the minor groups largely offset one another and there was only a slight drop in the weighted index number.

Dec. shipment from Germany. Revised quotations are:

	Bags	Bulk
Muriate of Potash 80–85% basis 80%	$36.00	$34.60
Sulphate of Potash 90–95% basis 90%	46.85	45.45
Sulphate of Potash Magnesia 48–53 % basis 48%	27.00	25.60
Manure Salt 30% basis 30%	21.55	18.55
Manure Salt 20%	15.30	12.30
Kainit 14%	12.40	9.40
Kainit 12.4%	11.90	8.90

These quotations are per ton of 2,000 lb. net weight. CIF customary Atlantic and Gulf ports. Prices are guaranteed against decline of German and French prices until April 30, 1927.

Ethyl Alcohol Production Gained in 1925

The Department of Commerce announces that, according to data collected at the biennial census of manufactures, 1925, the establishments engaged primarily in the manufacture of ethyl alcohol, mainly from molasses and grain, and related products, such as denatured rum, reported the production of ethyl alcohol to the value of $55,925,027, and of other products to the value of $1,780,677, making a total value of $57,705,704, an increase of 74.9 per cent as compared with $33,000,099 for 1923, the last preceding census year.

The statistics for 1925 and 1923 are presented in the following statement. The figures for 1925 are preliminary and subject to such corrections as may be found necessary upon further examination of the returns.

	1925	1923
Number of establishments	31	30
Wage earners (average number)*	1,395	1,062
Maximum month	Oct. 1,606	Dec. 1,356
Minimum month	Apr. 1,177	May 914
Per cent of maximum	73.3	67.4
Wages	$1,838,318	$1,474,166
Cost of materials (including fuel, electric power, and containers)	$38,564,481	$17,770,264
Products, total value	$57,705,704	$33,000,099
Ethyl alcohol	$55,925,027	†
Other products	$1,780,677	†
Value added by manufacture§	$19,141,223	$15,229,835
Horsepower	9,300	8,129

*Not including salaried employees.
†No comparable data.
§Value of products less cost of materials.

Rapid Growth in Production of Pyroxylin Lacquers

The Department of Commerce has issued figures showing paint and varnish production in this country for the six-months period from Jan. 1, to June 30, 1926. The figures are based on the semi-annual census of paint and varnish manufacturers. For the first half of 1926 as compared with those for the second half of 1925 they show decreases of 6.8 per cent and 3.9 per cent, respectively, for paste paints and ready-mixed and semi-paste paints, an increase of 10.7 per cent for varnishes, japans, and lacquers, other than pyroxylin, and an increase of 62.9 per cent for pyroxylin varnishes or lacquers.

The statistics are based upon the returns from 549 establishments, of which 79 reported the manufacture of pure white lead in oil; 159, combination or graded whites; 131, zinc oxide in oil; 324, other paste paints; 443, ready-mixed and semi-paste paints; 344, varnishes, japans, and lacquers, other than pyroxylin; and 111, pyroxylin varnishes or lacquers.

In the following table are given details of production and sales, by classes:

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	**133.76**
Last month	135.71
November, 1925	155.69
November, 1924	150.53

The action of the cottonseed oil market was again responsible for a lowering in the weighted index number for oils and fats. Prices for fats and greases were influenced by cotton oil values. Paint making oils held fairly steady.

PRODUCTION AND SALES OF PAINT AND VARNISH FIRST HALF 1926

			Establishments Reporting Sales			
			Sales			
	Total Production	Production, Amount	Total	Industrial	Trade Sales and all Others	Not Distributed By Class
	Lb.					
Paints						
Paste paint						
1926, January–June	209,022,800	184,143,600	180,620,000	21,103,200	148,849,600	10,667,200
1925, July–December	224,228,100	194,499,500	173,110,200	28,040,300	135,925,600	9,144,300
January–June	241,057,300	212,115,900	190,543,900	25,840,600	156,113,000	8,590,300
White lead in oil pure:						
1926, January–June	129,343,800	127,102,600	133,900,500	5,209,100	121,952,900	6,738,500
1925, July–December	132,841,700	130,459,300	123,101,500	7,843,100	109,815,500	5,442,900
January–June	150,417,100	147,961,800	141,076,300	8,711,900	127,168,900	5,195,500
Combination or graded whites:						
1926, January–June	11,634,300	8,119,000	7,828,000	1,191,100	5,784,500	852,400
1925, July–December	5,221,600	3,559,000	3,429,400	1,226,700	1,796,500	406,200
January–June	4,561,400	3,148,000	3,065,000	847,600	2,051,900	165,500
Zinc oxide in oil:						
1926, January–June	3,502,500	1,793,100	2,032,700	348,700	1,440,500	243,500
1925, July–December	6,334,100	4,373,500	4,057,000	330,900	3,415,400	310,700
January–June	7,297,200	5,621,600	5,767,800	485,600	5,034,900	247,300
Other paste paints:						
1926, January–June	64,542,200	47,128,900	36,858,800	14,354,300	19,671,700	2,832,800
Colors in oil	12,399,500	8,747,500	8,694,400	1,714,800	5,962,500	1,017,100
Colors in japan	2,809,800	2,317,800	2,278,100	795,900	1,327,900	154,300
Other	49,332,900	36,063,600	25,886,300	11,843,600	12,381,300	1,661,400
1925, July–December	79,850,700	56,107,700	42,522,300	18,639,600	20,898,200	2,984,500
January–June	78,781,600	55,384,500	40,634,800	15,795,500	21,857,300	2,982,000
Ready-mixed and semipaste paints, including enamels:	Gallons					
1926, January–June	45,402,100	37,314,300	36,878,900	11,861,100	18,886,000	6,131,800
Undercoating and primers	2,744,000	2,325,000	2,299,800	1,324,100	859,000	116,700
Wall paints and mill whites	7,393,100	6,149,300	6,166,300	1,409,300	3,939,000	818,000
Enamels, oil and varnish base	8,104,600	6,648,600	6,465,900	3,081,400	2,764,400	620,100
Other	27,160,400	22,191,400	21,946,900	6,046,300	11,323,600	4,577,000
1925, July–December	47,260,300	36,354,000	34,744,900	11,487,200	19,602,800	3,654,900
January–June	52,448,700	40,889,700	39,479,800	11,769,100	24,317,500	3,393,200
Varnishes, japans, and lacquers Other than pyroxylin:						
1926, January–June	38,081,400	30,423,000	27,335,100	14,547,000	9,653,000	3,135,100
Oleoresinous varnishes and varnish stains	23,739,400	18,012,600	15,603,500	7,284,100	6,163,400	2,156,000
Shellac varnishes	1,765,800	1,614,500	1,587,900	558,500	682,600	346,800
Other varnishes	5,830,700	4,598,900	4,265,700	2,489,500	1,598,900	177,300
Drying japans and dryers	3,152,000	2,776,000	2,519,600	1,369,000	853,100	297,500
Baking Japans	3,593,500	3,421,000	3,358,400	2,845,900	355,000	157,500
1925, July–December	34,399,000	24,962,200	20,969,000	12,682,100	6,856,000	1,430,900
January–June	36,514,400	27,754,100	22,598,900	13,005,000	7,804,600	1,789,300
Pyroxylin (nitrocellulose) products:						
1926, January–June	10,136,800	9,639,800	8,842,300	5,654,500	1,846,300	1,341,500
Clear lacquers	2,512,000	2,329,200	2,075,000	1,247,400	440,400	387,200
Lacquer enamels	3,528,800	3,375,600	3,176,000	1,801,700	874,300	500,000
Thinners for nitrocellulose lacquers	3,378,200	3,262,600	3,054,900	2,155,900	445,000	454,000
Other	717,800	672,400	536,400	449,500	86,600	300
1925, July–December	6,223,200	5,836,700	5,634,900	4,628,800	671,700	334,400
January–June	4,880,200	4,746,400	4,394,300	3,744,600	399,500	250,200
Allied Products						
1926, January–June						
Paint and varnish removers	361,200	320,100	471,500	74,100	379,300	18,100
Stains (not varnish stains)	1,489,700	887,700	828,300	276,800	450,800	100,700
Liquid fillers	422,200	372,800	366,500	199,000	163,100	4,400
	Lb.					
Paste fillers	6,565,400	5,906,400	5,616,900	3,970,500	1,485,500	160,900
Putty	23,862,400	19,543,800	19,609,000	4,933,200	8,393,500	6,282,300

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to November 15.

Industrial Chemicals

		Current Price	Last Month	Last Year
Acetone, drums	lb.	$0.12 -$0.13	$0.12 -$0.13	$0.12 -$0.13
Acid, acetic, 28%, bbl.	cwt.	3.25 - 3.50	3.25 - 3.50	3.12 - 3.37
Boric, bbl.	lb.	.09 - .10	.09 - .10	.08½- .10
Citric, kegs	lb.	.44½- .45	.44½- .47	.45½- .47
Formic, bbl.	lb.	.10½- .11½	.10½- .11	.10½- .10¾
Gallic, tech., bbl.	lb.	.50 - .55	.50 - .55	.45½- .47
Hydrofluoric 30% carb.	lb.	.06 - .07	.06 - .07	.06½- .07
Lactic, 44%, tech., light, bbl.	lb.	.13½- .14	.13½- .14	.13½- .14
22%, tech., light, bbl.	lb.	.06½- .07	.06½- .07	.06½- .07
Muriatic, 18°, tanks	cwt.	.80 - .85	.80 - .85	.80 - .85
Nitric, 36°, carboys	cwt.	.05 - .05½	.05 - .05¼	.05 - .05½
Oleum, tanks, wks.	ton	18.00 -20.00	18.00 -20.00	16.00- 17.00
Oxalic, crystals, bbl.	lb.	.11 - .11½	.10½- .11	10½- .11
Phosphoric, tech., c'bys.	lb.	.07 - .07½	.07 - .07½	.07½- .08
Sulphuric, 60°, tanks	ton	10.50 -11.00	10.50 -11.00	8.50 - 9.50
Tannic, tech., bbl.	lb.	.35 - .40	.35 - .40	.45 - .50
Tartaric, powd., bbl.	lb.	.28 - .30	.29 - .30	.27½- .30
Tungstic, bbl.	lb.	1.00 - 1.20	1.00 - 1.20	1.20 - 1.25
Alcohol, ethyl, 190 p'f. U.S.P. bbl	gal.	4.75 - 4.80	4.75 - 4.80	4.85 -
Alcohol, Butyl, dr.	lb.	.19½- .20½	.19½- .20½	.27 - .30
Denatured, 190 proof				
No. 1 special dr.	gal.	.31 - .36	.31 - .36	.54½-
No. 5, 188 proof, dr.	gal.	.31 - .33	.31 - .33	.53½-
Alum, ammonia, lump, bbl.	lb.	.03½- .04	.03½- .04	.03½- .04
Chrome, bbl.	lb.	.05½- .05½	.05½- .05½	.05½- .06
Potash, lump, bbl.	lb.	.02½- .03½	.02½- .03½	.02¾- .03½
Aluminum sulphate, com., bags	cwt.	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45
Iron free, bg.	cwt.	2.00 - 2.10	2.00 - 2.10	2.40 - 2.45
Aqua ammonia, 26°, drums	lb.	.03½- .04	.03½- .04	.06 - .06½
Ammonia, anhydrous, cyl.	lb.	.12 - .13	.13 - .15	.28 - .30
Ammonium carbonate, powd. tech., casks	lb.	.08½- .09	.08½- .09	.11 - .11½
Sulphate, wks.	cwt.	2.50 -	2.40 -	2.80 -
Amylacetate tech., drums	gal.	1.60 - 1.75	1.75 - 1.85	2.75 - 3.00
Antimony Oxide, bbl.	lb.	.16½- .16½	.16 - .16½	.16 - .16½
Arsenic, white, powd., bbl.	lb.	.03½- .04½	.03½- .04¼	.03½- .04½
Red, powd., kegs	lb.	.10½- .11	.10½- .11	.12 - .12½
Barium carbonate, bbl.	ton	50.00 -52.00	51.00 -52.00	48.00 -50.00
Chloride, bbl.	ton	65.00 -67.00	63.00 -65.00	60.00 -62.00
Nitrate, cask	lb.	.07½- .08	.07¼- .08½	.07½- .08
Blanc fixe, dry, bbl.	lb.	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f.o.b., wks., drums	cwt.	2.00 - 2.10	2.00 - 2.10	1.90 -
Borax, bbl.	lb.	.04½- .05	.05 - .05½	.05 - .05½
Bromine, cs.	lb.	.45 - .47	.45 - .47	.47 - .48
Calcium acetate, bags	cwt.	3.25 - 3.50	3.25 - 3.50	3.00 - 3.25
Arsenate, dr.	lb.	.08½- .11	.08½- .10	.07 - .08
Carbide drums	lb.	.05½- .06	.05½- .06	.05 - .05½
Chloride, fused, dr., wks.	ton	21.00 -	21.00 -	21.00 -
Phosphate, bbl.	lb.	.07 - .07½	.07 - .07½	.06½- .07½
Carbon bisulphide, drums	lb.	.05½- .06	.05½- .06	.06 - .06½
Tetrachloride drums	lb.	.07 - .07½	.06½- .06½	.05½- .07
Chlorine, liquid, tanks, wks.	lb.	.04 - .04½	.04 - .04½	.04 - .04½
Cylinders	lb.	.05½- .08	.05½- .08	.05½- .08
Cobalt oxide, cans	lb.	2.00 - 2.10	2.10 - 2.20	2.10 - 2.25
Copperas, bgs., f.o.b. wks.	ton	13.00 -14.00	16.00- 18.00	12.00 -13.00
Copper carbonate, bbl.	lb.	.17 - .17½	.17 - .18	.16½- .17
Cyanide, tech., bbl.	lb.	.49 - .50	.49 - .50	.49 - .50
Sulphate, bbl.	cwt.	4.80 - 4.90	4.75 - 5.00	4.50 - 4.60
Cream of tartar, bbl.	lb.	.21 - .22	.21 - .22	.21½- .22
Epsom salt, dom., tech., bbl.	cwt.	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00
Imp., tech., bags	cwt.	1.15 - 1.25	1.15 - 1.25	1.35 - 1.40
Ethyl acetate, 85% drums	gal.	.77 - .78	.74 - .76	.87 - .90
99%, dr.	gal.	1.05 -	.95 - .96	1.03 - 1.06
Formaldehyde, 40%, bbl.	lb.	.10½- .11½	.10½- .10¾	.08½- .09
Furfural, dr.	lb.	.15 - .17½	.15 - .17½	.23 -
Fusel oil, crude, drums	gal.	1.35 - 1.40	1.40 - 1.50	2.40 - 2.50
Refined, dr.	gal.	2.50 - 3.00	2.50 - 3.00	3.25 - 3.50
Glaubers salt, bags	cwt.	1.00 - 1.15	1.00 - 1.10	1.20 - 1.40
Glycerine, c.p., drums, extra.	lb.	.30 - .31	.29 - .30	.22 - .23
Lead:				
White, basic carbonate, dry, casks	lb.	.10½-	.10½-	.10½-
White, basic sulphate, sck.	lb.	.10 -	.10 -	.10 -
Red, dry, sck	lb.	.11½-	.12 -	.12½-
Lead acetate, white crys., bbl.	lb.	.14½- .15	.14½- .15	.14½-
Lead arsenate, powd., bbl.	lb.	.14 - .15	.14 - .15	.13 - .14
Lime, chem., bulk	ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk	lb.	.11 -	.11½-	.12 -
Lithopone, bags	lb.	.05½- .06	.05½- .06	.06 - .06½
Magnesium carb., tech., bags.	lb.	.06½- .06½	.06½- .06½	.06½- .07
Methanol, 95%, dr.	gal.	.73 - .75	.71 - .72	.58 - .62
97%, dr.	gal.	.75 - .77	.72 - .73	.60 - .64
Nickel salt, double, bbl.	lb.	.10 - .10½	.10 - .10½	.09 - .10
Single, bbl.	lb.	.10½- .11	.10½- .11	.10 - .11
Orange mineral, csk.	lb.	.13½-	.14½-	.16 -
Phosphorus, red, cases	lb.	.62 - .65	.62 - .65	.70 - .75
Yellow, cases	lb.	.32 - .33	.32 - .34	.34 - .36
Potassium bichromate, casks.	lb.	.08½- .08½	.08½- .08½	.08½- .08½
Carbonate, 80-85%, calc., csk.	lb	.05½- .06	.06 -	.06 - .06½
Chlorate, powd.	lb.	.08½- .09	.08½- .09	.08¾- .09
Cyanide, cs.	lb.	.55 - .57	.55 - .58	.47 - .62
First sorts, csk.	lb.	$0.09 -$0.09½	$0.08½-$0.09	$0.08½-$0.08½
Hydroxide(c'stic potash) dr.	lb.	.07½- .07¾	.07½- .07¾	.07¼- .07½
Muriate, 80% bgs.	ton	34.90 -	34.90 -	34.55 -
Nitrate, bbl.	lb.	.06 - .06½	.06½- .06½	.06 - .07½
Permanganate, drums	lb.	.14 - .15	.14 - .15	.14½- .15
Prussiate, yellow, casks	lb.	.18½- .18½	.18½- .18½	.18½- .18½
Sal ammoniac, white, casks.	lb.	.05½- .06	.05½- .06½	.05½- .06
Salsoda, bbl.	cwt.	.90 - .95	.85 - .95	1.10 - 1.20
Salt cake, bulk	ton	17.00 -18.00	17.00 -18.00	17.00 -19.00
Soda ash, light, 58%, bags, contract	cwt.	1.38 -	1.38 -	1.38 -
Dense, bags	cwt.	1.45 - 1.55	1.45 - 1.55	1.45 - 1.55
Soda, caustic, 76%, solid, drums, contract	cwt.	3.10 -	3.10 -	3.10 -
Acetate, works, bbl.	lb.	.04½- .05¼	.04½- .05	.04½- .05
Bicarbonate, bbl.	cwt.	2.00 - 2.25	2.00 - 2.25	1.75 - 2.00
Bichromate, casks	lb.	.06½- .06¾	.06½- .06½	.06½- .06¾
Bisulphate, bulk	ton	5.00 - 5.50	5.00 - 5.50	6.00 - 7.00
Bisulphite, bbl.	lb.	.03½- .04	.03½- .04	.04¼- .04½
Chlorate, kegs	lb.	.06½- .06½	.06½- .06½	.06½- .06½
Chloride, tech.	ton	12.00- 14.75	12.00- 14.75	12.00 -14.00
Cyanide, cases, dom.	lb.	.18 - .22	.18 - .22	.19 - .22
Fluoride, bbl.	lb.	.09 - .09½	.09 - .09½	.09 - .09½
Hyposulphite, bbl.	lb.	2.50 - 3.00	2.50 - 3.00	.02½- .02¾
Nitrate, bags	cwt.	2.54 -	2.52 -	2.59 -
Nitrite, casks	lb.	.08½- .09	.08½- .09	.09 - .09½
Phosphate, dibasic, bbl.	lb.	.03½- .03¾	.03½- .03¾	.03½- .03¾
Prussiate, yel. drums	lb.	.10½- .10½	.10½- .10½	.10½- .10¾
Silicate (30°, drums)	cwt.	.75 - 1.15	.75 - 1.15	.75 - 1.15
Sulphide, fused, 60-62%, dr.	lb.	.03 - .03½	.03 - .03½	.02½- .03
Sulphite, crys., bbl.	lb.	.03 - .03½	.03 - .03½	.02½- .03
Strontium nitrate, bbl.	lb.	.08½- .09	.08½- .09	.09½- .10
Sulphur, crude at mine, bulk.	ton	19.00 -	19.00 -	15.00 -16.00
Chloride, dr.	lb.	.05 - .05½	.05 - .05½	.04½- .05
Dioxide, cyl.	lb.	.09 - .10	.09 - .10	.08½- .09
Flour, bag	cwt.	2.70 - 3.00	2.70 - 3.00	2.25 - 2.35
Tin bichloride, bbl.	lb.	.27½-	.19 -	.17½-
Oxide, bbl.	lb.	.72 -	.70 -	.64 -
Crystals, bbl.	lb.	.48 -	.45½-	.41 -
Zinc chloride, gran., bbl.	lb.	.07 - .07½	.07 - .08	.06 - .07½
Carbonate, bbl.	lb.	.11 - .11½	.11 - .11½	.12 - .14
Cyanide, dr.	lb.	.40 - .41	.40 - .41	.40 - .41
Dust, bbl.	lb.	.09 - .10	.09 - .10	.08 - .08½
Zinc oxide, lead free, bag.	lb.	.07½-	.07½-	.07½-
5% lead sulphate, bags	lb.	.07 -	.07 -	.06½-
Sulphate, bbl	cwt	2.75 - 3.00	2.75 - 3.00	3.50 - 3.75

Oils and Fats

		Current Price	Last Month	Last Year
Castor oil, No. 3, bbl.	lb.	$0.12½-$0.13	$0.12½-$0.13	$0.16½-$0.17
Chinawood oil, bbl.	lb.	.16½-	.17½-	.13½- .14
Coconut oil, Ceylon, tanks, N. Y.	lb.	.09½-	.09 -	.13 -
Corn oil crude, tanks, (f.o.b. mill)	lb.	.08 -	.08 -	.12 -
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.06½-	.07½-	.08½-
Linseed oil, raw, car lots, bbl.	lb.	11.1 -	11.0 -	14.0 -
Palm, Lagos, casks	lb.	.08½- .08¾	.08½- .9¼	.08½-
Niger, casks	lb.	.08½-	.08½-	.08½-
Palm Kernel, bbl.	lb.	.10½-	.10½- .11	.09½-
Peanut oil, crude, tanks (mill)	lb.	.10 -	.11 -	.09½-
Perilla, bbl.	lb.	-	.15 - .15½	.14½-
Rapeseed oil, refined, bbl.	gal.	.83 - .84	.85 - .90	.95 - .98
Sesame, bbl.	lb.	-	-	.15 - .15½
Soya bean tank (f.o.b. Coast)	lb.	.10½-	.10½-	.11½-
Sulphur(olive foots), bbl.	lb	.09½-	.08½-	.08½-
Cod, Newfoundland, bbl	gal	.66 - .68	.65 - .66	.64 - .65
Menhaden, light pressed, bbl	gal	.65 - .67	.65 - .67	.76 - .78
Crude, tanks (f.o.b. factory)	gal	.47 -	.45 -	.50 -
Whale, crude, tanks	lb.	-	-	-
Grease, yellow, loose	lb.	.06½-	.08 -	.09 - .09½
Oleo stearine	lb.	.10½-	.12 -	.13½-
Red oil, distilled, d.p. bbl.	lb.	.10 - .10½	.10 - .10½	.11½- .11½
Tallow, extra, loose	lb.	.07½-	.08½-	.09½-

Coal-Tar Products

		Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl	lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl	lb.	.85 - .90	.85 - .90	.75 - .80
Alpha-naphthylamine, bbl.	lb.	.35 - .36	.35 - .36	.35 - .36
Aniline oil, drums, extra	lb.	.16 - .17	.16 - .16½	.17 - .17½
Aniline salts, bbl	lb.	.22 - .24	.20 - .22	.20 - .22
Anthracene, 80%, drums	lb.	.60 - .65	.60 - .65	.65 - .70
Benzaldehyde, U.S.P., dr.	lb	1.15 - 1.25	1.15 - 1.35	1.50 -
Benzidine base, bbl.	lb.	.70 - .72	.70 - .75	.78 - .82
Benzoic acid, U.S.P., kgs.	lb.	.58 - .60	.58 - .60	.75 - .85
Benzyl chloride, tech, dr	lb.	.25 - .26	.25 - .26	.35 - .36
Benzol, 90%, tanks, works	gal.	.24 - .25	.25 - .28	.24 - .25
Beta-naphthol, tech., drums	lb.	.22 - .24	.22 - .24	.24 - .25
Cresol, U.S.P., dr.	lb.	.18 - .20	.18 - .20	.23 - .25
Cresylic acid, 97%, dr., wks	gal.	.57 - .60	.59 - .63	.59 - .62
Diethylaniline, dr	lb.	.58 - .60	.58 - .60	.59 - .61
Dinitrophenol, bbl.	lb.	.31 - .35	.31 - .33	.35 - .38
Dinitrotoluen, bbl.	lb.	.17 - .18	.17 - .18	.18 - .20
Dip oil, 25% dr.	gal.	.28 - .30	.28 - .30	.26 - .28
Diphenylamine, bbl.	lb.	.45 - .47	.48 - .50	.48 - .50
H-acid, bbl.	lb.	.63 - .65	.63 - .65	.70 - .74

Coal-Tar Products—Continued

		Current Price	Last Month	Last Year
Naphthalene, flake, bbl.	lb.	$0.05¼-$0.06	$0.05¼-$0.06	$0.05 -$0.05½
Nitrobenzene, dr.	lb.	.09 - .10	.09 - .10	.09 - .10
Para-nitraniline, bbl	lb.	.52 - .53	.45 - .50	.65 - .67
Para-nitrotoluine, bbl.	lb.	.28 - .32	.28 - .32	.40 - .42
Phenol, U.S.P., drums	lb.	.17 - .19	.17 - .19	.22 - .24
Picric acid, bbl.	lb.	.30 - .40	.30 - .40	.25 - .26
Pyridine, dr.	lb.	3.60 -.....	4.10 -.....	4.10 - 4.20
R-salt, bbl.	lb.	.47 - .50	.40 - .44	.50 - .55
Resorcinal, tech, kegs.	lb.	1.30 - 1.35	1.35 - 1.40	1.30 - 1.40
Salicylic acid, tech., bbl	lb.	.30 - .32	.30 - .32	.32 - .33
Solvent naphtha, w.w.,tanks	gal.	.35 -.....	.35 -.....	.26 - .26
Tolidine, bbl.	lb.	.95 - .95	.95 - .96	1.00 - 1.05
Toluene, tanks, works	gal.	.35 -.....	.35 -.....	.26 -.....
Xylene, com., tanks	gal	36 - .41	.36 - .41	.26 - .27

Miscellaneous

		Current Price	Last Month	Last Year
Barytes, grd., white, bbl.	ton	$23.00-$25.00	$23.00-$25.00	$20.00-$22.00
Casein, tech., bbl.	lb.	.15 - .16	.16½- .18½	.13 - .14
China clay, powd., f.o.b. Va.	ton	10.00 -20.00	10.00 -20.00	10.00 -20.00
Imported, powd.	ton	45.00 -50.00	45.00 -50.00	45.00 -50.00
Dry colors:				
Carbon gas, black (wks.)	lb.	.08 - .08½	.08 - .08½	.07 - .07½
Prussian blue, bbl	lb.	.32 - .33	.32 - .34	.34 - .36
Ultramine blue, bbl.	lb.	.08 - .35	.08 - .35	.08 - .35
Chrome green, bbl.	lb.	.28 - .30	.28 - .30	.27 - .29
Carmine red, tins	lb.	5.00 - 5.10	5.00 - 5.10	4.50 - 4.75
Para toner	lb.	.80 - .90	.80 - .90	.90 - .95
Vermilion, English, bbl.	lb.	1.55 - 1.60	1.45 - 1.50	1.35 - 1.40
Chrome yellow, C. P., bbl.	lb.	.17 - .18	.17½- .18	.18 - .19
Feldspar, No. 1 (f.o.b. N. C.)	ton	5.50 - 6.50	6.00 - 6.50	5.50 - 6.00
Graphite, Ceylon, lump, bbl	lb.	.07 - .09½	.07 - .09½	.08½- .09
Gum copal, Congo, bags.	lb.	.09½- .10	.09½- .10	.08 - .10
Manila, bags.	lb.	.15 - .18	.15 - .16	.14 - .16
Damar, Batavia, cases	lb.	.25 - .25½	.25 - .26	.28½- .28½
Kauri, No. 1 cases	lb.	.55 - .57	.57 - .65	.58 - .62
Kieselguhr (f.o.b. N. Y.)	ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc.	ton	44.00 -.....	44.00 -.....	40.00 -41.00
Pumice stone, lump, bbl.	lb.	.05 - .07	.05 - .08	.06 - .08
Imported, casks.	lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H.	bbl.	14.35 -.....	15.85 -.....	11.50 -.....
Turpentine	gal.	.88 -.....	.93 -.....	1.14 -.....
Shellac, orange, fine, bags	lb.	.45 - .47	.29 - .30	.52 - .53
Bleached, bonedry, bags	lb.	.53 - .54	.36 - .40	.59 - .62
T. N. bags.	lb.	.43 - .45	.27 - .28	.49 - .51
Soapstone (f.o.b. Vt.), bags.	ton	10.00 -12.00	10.00 -12.00	9.00 -11.00
Talc, 200 mesh (f.o.b. Vt.)	ton	11.00 -.....	11.00 -.....	10.50 -.....
200 mesh (f.o.b. Ga.)	ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
325 mesh (f.o.b. N. Y.)	ton	14.75 -.....	14.75 -.....	14.75 -.....
Wax, Bayberry, bbl.	lb.	.31 - .35	.21 - .22	.20 - .21
Beeswax, ref., light	lb.	.45 - .46	.47 - .48	.40 - .42
Candelilla, bags	lb.	.34 - .35	.34 - .35	.30 - .31
Carnauba, No. 1, bags	lb.	.56 - .58	.50 - .51	.37 - .38
Paraffine, crude 105-110 m.p.	lb	.05½- .06	.06 - .06½	.06 -.....

Ferro-Alloys

		Current Price	Last Month	Last Year
Ferrotitanium, 15-18%	ton	$200.00-	$200.00-.....	$200.00-.....
Ferrochromium, 1-2%	lb.	.23- .25	.23- .35	.24-.....
Ferromanganese, 78-82%	ton	88.00-90.00	88.00-90.00	115.00-.....
Spiegeleisen, 19-21%	ton	32.00-34.00	32.00-34.00	32.00-.....
Ferrosilicon, 10-12%	ton	33.00-38.00	33.00-38.00	39.50-43.00
Ferrotungsten, 70-80%	lb.	1.00- 1.05	.95- 1.15	.90- ...
Ferro-uranium, 35-50%	lb.	4.50-.....	4.50-.....	4.50-.....
Ferrovanadium, 30-40%	lb.	3.40- 4.00	3.25- 4.00	3.25- 3.75

Non-Ferrous Metals

		Current Price	Last Month	Last Year
Copper, electrolytic	lb.	$0.13½-.....	$0.14¼-.....	$0.14¼-$0.15½
Aluminum, 96-99%	lb.	.27 - .28	.27 - .28	.27 - .28
Antimony, Chin. and Jap.	lb.	.13 - .13½	.14½- .15	.20½-.....
Nickel, 99%	lb.	.35 -.....	.35 -.....	.31 - .32
Monel metal, blocks	lb.	.32 - .33	.32 - .33	.32 - .33
Tin, 5-ton lots, Straits	lb.	.70½-.....	.72 -.....	.57½-.....
Lead, New York, spot	lb.	8.00 -.....	8.35 -.....	.09 -.....
Zinc, New York, spot	lb.	7.60 -.....	7.70 -.....	.07½-.....
Silver, commercial	oz.	.54¼-.....	.54 -.....	.63¼-.....
Cadmium	lb.	.60 -.....	.60 -.....	.60 -.....
Bismuth, 500-lb. lots	lb.	2.70 - 2.75	2.70 - 2.75	1.30 - 1.35
Cobalt	lb.	2.50 -.....	2.50 -.....	2.50 - 3.00
Magnesium, ingots, 99%	lb.	.75 - .80	.75 - .80	.90 - .95
Platinum, ref.	oz.	112.00-.....	112.00-.....	117.00-.....
Palladium, ref.	oz.	68.00- 70.00	68.00- 69.00	78.00-.....
Mercury, flask	75 lb.	100.00-.....	95.50-	79.00-80.00
Tungsten powder	lb.	1.05- 1.15	1.10-.....	.95- 1.00

Ores and Semi-finished Products

		Current Price	Last Month	Last Year
Bauxite, crushed, wks.	ton	$5.50- $8.50	$5.50- $8.50	$5.50- $8.75
Chrome ore, c.f. post	ton	21.00- 24.00	22.50- 24.00	18.50- 24.00
Coke, fdry., f.o.b. ovens	ton	3.75- 4.25	3.75- 4.25	4.75- 5.00
Fluorspar, gravel, f.o.b. Ill.	ton	18.00-.....	18.00-.....	17.50- 18.50
Ilmenite, 52% TiO_2, Va.	lb.	.0¾- .0¾	.01½-.....	.01½-.....
Manganese ore, 50% Mn., c.i.f. Atlantic Ports	unit	.28 - .30	.35 - .36	.42 - .43
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y.	lb.	.48 - .50	.50 - .55	.60- .70
Monazite, 6% of ThO_2	ton	120.00-.....	120.00-.....	120.00-.....
Pyrites, Span. fines, c.i.f.	unit	.13½-.....	13¾-.....	.11½- .12
Rutile, 94-96% TiO_2	lb.	.12 - .15	.12 - .15	.12 - .15
Tungsten, scheelite, 60% WO_3 and over	unit	11.00 -11.25	12.50 -13.00	9.50 - 9.75
Vanadium ore, per lb. V_2O_5	lb.	.25 - .28	.30 - .35	1.00 - 1.27
Zircon, 99%	lb.	.03 -.....	.03 -.....	.06 - .05

Current Industrial Developments

New Construction and Machinery Requirements

New England

Conn., Fairfield—McKesson & Robbins Inc. Grasmere Ave. and the Girard Co., have consolidated and are having plans prepared for the construction of a 2 story, 25 x 100 ft. drug and chemical plant. Estimated cost $20,000. Private plans.

Conn., Hartford—Hartford Faience Co., Faience St., manufacturers of porcelain, awarded contract for the construction of a 2 story 60 x 82 ft. plant to Industrial Construction Co., 721 Main St. Estimated cost $45,000.

Conn., Wallingford—M. Backes & Sons Inc., 15 Wallace St., manufacturers of paper cap torpedoes, awarded contract for the construction of a 1 story, 45 x 128 ft. plant to C. F. Wooding Co., Masonic Ave. Estimated cost $25,000.

Me., Farmington—Ted Toys-Lers Inc., 55 South Water St., New Bedford, Mass., is receiving bids for the construction of a 32 x 130 ft. mill and 32 x 40 ft. enameling room, etc. Leary & Walker, First National Bank Bldg., New Bedford, Mass., are architects.

Me., Portland—Portland Monson Slate Co., Central Wharf, plans the reconstruction of a 1 and 2 story plant recently destroyed by fire. Estimated cost $40,000.

Me., Thomaston—Lawrence Portland Cement Co., F. Smith, Pres., Northampton, Pa., is reported to have acquired a site and having plans prepared for the construction of a branch mill here. Estimated cost $1,200,000.

Mass., Forest Hills (Boston P. O.)—Harvard University, c/o Stevens & Lee, 45 Newbury St., Boston, Archts., is receiving bids on revised plans for the construction of a 2 story addition to anti-toxin laboratory. Estimated cost $150,000.

Mass., Lynn—Lynn Tanning Co., 35 Boston St., is receiving bids for the construction of a 3 story addition to factory at Boston St. and North Bend. Estimated cost $40,000. J. Schwartz, 25 Central Sq., is architect.

Mass., Peabody—Frank Espindle Co., 14 Collins St. manufacturers of sole leather, awarded contract for the construction of a 2 story factory to M. F. Gourley, 12 Bay Ave. Estimated cost $40,000.

Mass., Salem—L. Pedrick, 9 Ocean Ave., is receiving bids for the construction of a 3 story warehouse and laboratory near Washington St. Estimated cost $150,000. W. Chapman, 15 Ashburton Pl., Boston, is architect.

Mass., Waltham (Boston P. O.)—T. B. Plimpton, 220 Devonshire St., Boston, manufacturer of mica, is in the market for additional machinery and equipment for proposed extension to factory here.

Middle Atlantic

Del., New Castle—Delaware Rayon Co., awarded contract for the construction of a 1 story, 50 x 80 ft. plant to The Austin Co., Jefferson Bldg., Philadelphia, Pa.

Md., Baltimore—Crosse & Blackwell Ltd., 146 West 22nd St., New York, N. Y., manufacturers of food stuffs, is having plans prepared for the construction of a plant on Eastern Ave. here. Estimated cost $1,000,000. Clark, MacMullen & Riley, 101 Park Ave., New York, N. Y., are engineers.

N. Y., West Nyack—Kay Research Corp., Union Trust Bldg., Pittsburgh, Pa., manufacturers of processing apparatus, awarded contract for the construction of a 1 story, 60 x 100 ft. plant here to Beers Tapman Inc., 15 Park Row, New York City. Estimated cost $40,000.

Pa., Harrisburg—Harrisburg Gas Co., plans extensions to artificial gas plant and installation of additional equipment. Estimated cost $250,000.

Pa., Milton—Milton Silk Dyeing Co., c/o Shamokin Lumber & Construction Co., 37 South 5th St., Shamokin, Gen. Contr., will build a 1 story plant here. Estimated cost $500,000. Work will be done by separate contracts.

Pa., Oaks—Philadelphia Rubber Works, Land Title Bldg., Philadelphia, awarded contract for the construction of a 1 story, 50 x 220 ft. addition to plant here to F. R. Heavner, Norristown.

Pa., Philadelphia—Craftex Mills, J. A. Houseman, Secy., 1806 East Venango St., will have revised plans prepared for the construction of a 3 story, 43 x 50 ft. factory at Venengo and Kensington Ave. A. W. Barnes, Perry Bldg. 16th and Chestnut Sts., is architect.

Pa., Philadelphia—Laurel Soap Mfg. Co., Hope and Palmer Sts., awarded contract for the construction of a 2 story, 80 x 250 ft. factory at Tioga and Almond Sts. to J. N. Gill Co., City Center Bldg.

Pa., Pittsburgh—The National Tube Co., Frick Bldg., will soon receive bids for the construction of a 2 story, 58 x 109 ft. research laboratory on Forbes St. Estimated cost $150,000. E. Stotz, Monongahela Bank Bldg., is architect.

tion of a plant. Estimated cost including equipment $1,000,000. Cowham Engineering Co., 111 West Monroe St., Chicago, Ill., is engineer.

Ky., Mayfield—F. L. Kronenberg, Carroll Blk, Madison, Wis., Archt., is receiving bids for the construction of a 1 and 2 story, 120 x 150 ft. condensary here, for Golden Key Milk Products Co., Washington Bldg., Madison, Wis. Estimated cost $50,000.

La., Alexandria—National Lumber & Creosting Co., W. W. Lawson, has acquired a site at Texas, Pacific & Louisiana R.R. tracks, and plans the construction of a creosting plant.

La., Baton Rouge—University of Louisiana, awarded contract for the construction of a 3 story, 60 x 160 ft. laboratory to Caldwell Bros., 816 Howard Ave., New Orleans. Estimated cost $80,955.

La., Monroe—The Brown Paper Mill Co. awarded contract for the construction of addition to paper mill including 40 x 404 ft. machine and finishing room, 54 x 73 ft. wash room, 36 x 54 ft. digester house, 72 x 90 ft. recovery room, all 2 story and 37 x 54 ft. mud filter room, to Morton C. Tuttle Co., 862 Park Sq. Bldg., Boston, Mass.

N. C., Raleigh—Buckeye Cotton Oil Co., Gwynne Bldg., Cincinnati, O., plans the construction of a cotton oil mill here. Estimated cost $400,000 to $500,000.

Tenn., Doyle—Southern Paint & Pigment Co., D. Young, Pres., plans the construction of a pigment plant, also mining operations for lime and ochre.

Tenn., Lewisburg—Borden Milk Co., 350 Madison Ave., New York, N. Y., awarded contract for the construction of a milk condensing plant here to H. K. Ferguson Co., 4900 Euclid Ave., Cleveland, O. Estimated cost $400,000 to $500,000.

Middle West

Ill., Chicago—W. J. Stange Co., 2549 Madison St., manufacturers of flavoring extracts, awarded contract for the construction of a 3 story, 49 x 56 ft. factory. Estimated cost $22,750. Weiss & Neestadt, 53 West Jackson Blvd., are architects.

Ind., Evansville — Evansville Enamel Works, 2107 Fulton St., is having plans prepared for the construction of a 1 story, 100 x 130 ft. factory at Fulton St. and Belt R.R. Estimated cost $60,000. Fowler & Karges, Furniture Bldg., are architects.

Ind., Indianapolis—Advance Paint Co., T. J. Kelly, Pres., 4305 College Ave., awarded contract for the construction of a 2 story, 29 x 148 ft. plant to E. Newell, 4207 Bowman St. Estimated cost $42,000.

Ind., Indianapolis—Republic Creosoting Co., 1614 Merchants Bank Bldg., awarded contract for the construction of a 2 story, 45 x 132 ft. factory to Schelegal & Roehm, 602 Lexington St. Estimated cost $40,000.

Mich., Detroit—Detroit Candy Co. Ltd., H. C. Martin, Secy., 1528 Gratiot Ave., is having plans prepared for the construction of a 3 story, 70 x 100 ft. factory and office at Dubois and Brewster Sts. Estimated cost $150,000. Smith, Hinchman & Grylls, 800 Marquette Bldg., are architects and engineers.

Mich., Detroit—Peninsular Stove Co., Fort Street & Trumbull Ave., is in the market for complete equipment for the manufacture of stoves for proposed 1 and 2 story, 750,000 sq.ft. factory on Burt Rd.

Mich., Detroit—Semet Solvay Co., Solvay St., plans the construction of 50 new coke ovens, 900 ton daily capacity. Private plans. Work will be done under owners' supervision. Equipment including conveyors will be required.

O., Akron—Firestone Tire & Rubber Co., 1289 South Main St., will soon award contract for the construction of a 6 story, 45 x 190 ft., factory. Wilbur Watson & Associates, 4614 Prospect Ave., Cleveland, are architects. E. A. Hoener, c/o Firestone Steel Products Co., Wilbreth Rd., is chief engineer. Tire building, finishing and curing machinery will be required.

O., Akron—The Goodyear Tire & Rubber Co., East Market St., awarded contract for the construction of a 3 story, 50 x 200 ft. two 5 story, 80 x 200 ft. and three 3 story, 80 x 200 ft. factory buildings to Clemmer & Johnson, 406 Metropolitan Bldg. Estimated cost $500,000.

O., Cleveland—The Fuller Cleaning Co., 7606 Carnegie Ave., awarded contract for the construction 4 story, 37 x 72 ft., addition to factory to William Dunbar Co., 8201 Cedar Ave. Estimated cost $70,000.

O., Cleveland—National Carbon Co., R. C. Frazer, Purch. Agt., West 117th St. and Madison Ave., awarded contract for the construction of a 2 story, 70 x 250 ft. factory on Berea Rd. to A. A. Lane Construction Co., 1869 East 55th St. Estimated cost $150,000.

O., Dayton—Inland Manufacturing Co., Coleman Ave., manufacturers of hard and soft rubber products, awarded contract for the construction of a 1 story, 123,000 sq.ft. factory to Frank Hill Smith Inc., Winter Bldg. Estimated cost $250,000.

O., Excello—The Crystal Tissue Co., E. A. Cahill, Secy., Middletown, plans the construction of a 1 story, 65 x 225 ft. addition to paper mill here. Estimated cost $80,000. Architect not selected.

O., Rossford—Larrowe Milling Co., Dixie Highway, Toledo, awarded contract for the construction of a factory here to A. Bentley & Sons Co., 201 Belmont Ave., Toledo. Betaine hydrochloride, glutamino acid and methyl amines will be produced with hydrochloric acid, sodium sulphate and potassium chloride as byproducts.

Wis., Random Lake—Sommer & Sons, is having preliminary plans prepared for the construction of a 2 story, 60 x 120 ft. condensary. Estimated cost $50,000. E. A. Stubenrauch, 629 North 8th St., Sheboygan is architect. Special machinery and motors will be required.

West of Mississippi

Ark., Ft. Smith — Missouri Arkansas Oxygen Co., 1001 Wheeler St., plans extensions and improvements to plant. Estimated cost $30,000. Private plans. New oxygen equipment will be required.

Minn., Minneapolis—State Commission of Administration and Finance, State Capitol, St. Paul, will soon award contract for the construction of a 4 story physics laboratory at State University here. Estimated cost $450,000. C. H. Johnson, 360 Robert St., St. Paul, is architect. Equipment will be required.

Mo., Cape Girardeau—Missouri Utilities Co., plans the construction of a gas plant. Estimated cost $40,000. Private plans. A carbonated water gas set will be installed.

Mo., Continental—Alpha Portland Cement Co., 140 South Dearborn St., Chicago, Ill., is having plans prepared for the construction of a 5 story addition to branch plant here. Estimated cost including equipment $80,000. C. N. McClarnem, La Salle, Ill., is chief engineer.

Mo., Kansas City—Alliance Rubber Producing Co. is reconditioning the refinery formerly operated by Interstate Refineries Co. at Twenty-Third St. and Lister Ave. for the production of mineral rubber from crude oil.

Mo., Kansas City—Hinde & Dauch Paper Co., 401 West Water St., Sandusky, O., plans the construction of a fibre board mill here. Estimated cost $1,500,000. Private plans.

Mo., Kansas City—U. S. Gypsum Co., 205 West Monroe St., Chicago, Ill., awarded contract for the construction of a 1 and 2 story plant here to Bickel Construction Co., 903 Pioneer Trust Bldg., Kansas City, Mo. Estimated cost $500,000.

Mo., St. Louis—Asbestos Shingle Slate & Sheathing Co., Ambler, Pa., awarded contract for the construction of a 1 story, 50 x 150 ft. factory Bellefontain Rd. and Burlington R.R. to Fruin-Colnon Construction Co., Merchants Laclede Bldg. Estimated cost $150,000.

Tex., Alice—American Bottling Co., has acquired a site and plans the construction of a bottling plant. Estimated cost $60,000. Private plans. Machinery and equipment to cost about $15,000 will be required.

Tex., Beeville—Taft Ranch Interests, Taft, have acquired the Beeville Cotton Seed Oil Mill and is having surveys made for extension and improvements here. Estimated cost $40,000. Private plans.

Tex., Breckenridge—Phillips Petroleum Co., Bartlesville, Okla., had plans prepared for the construction of a gasoline refinery near here. Estimated cost including equipment $100,000.

Tex., Brownfield—Amarillo Oil & Potash Co., W. L. Kingsland, Pres., is in the market for boring machines, hoists, engines, screeners, dippers, etc. to develop potash deposits here.

Tex., Cooledge—Munger Cotton Oil Co., plans to rebuild cotton oil plant recently destroyed by fire. Estimated cost $35,000. Private plans.

Tex., Gilmer—Gilmer Cotton Oil & Fertilizer Co., plans the construction of a fertilizer plant, 24 ton capacity. Estimated cost $40,000. Bids will be received until Jan. 1 for fertilizer mixing equipment.

Tex., Phillips—Alamo Refining Co., 100 Central Bldg., Amarillo, is having preliminary plans prepared for the construction of an additional oil refinery to increase the capacity of plant here. Estimated cost $1,000,000.

Far West

Calif., Oakland—De Sanno Foundry & Machine Co., 2941 East 12th St., manufacturers of brass, bronze and aluminum castings, has acquired a site and plans the construction of a foundry on East 14th St. Estimated cost $40,000.

Calif., Pittsburgh—Pioneer Rubber Mills, 353 Sacto St., San Francisco, awarded contract for the construction of a factory here. to Lindgren & Swinerton Inc., 225 Bush St., San Francisco. Estimated cost $100,000.

Calif., Southgate (Los Angeles P. O.)—National Paper Products Co., 111 South Garvy St., awarded contract for the construction of a 1 story, 275 x 500 ft. factory to Barrett & Hilp, 918 Harrison St., San Francisco. Estimated cost $300,000.

Calif., Wilmington—Shell Oil Co. of California, 108 West 2nd St., plans the construction of first unit of refinery. Estimated cost $1,000,000. Ultimate total cost $6,500,000. Private plans.

Wash., Longview—Longview Fibre Co., will build a pulp mill by day labor. R. A. Wertheimer, Kaukauna, Wis., Engr. is receiving bids on materials also pulp grinding machines.

Wash., Olympia—Olympia Pulp & Paper Co., L. W. David, Mgr., Seattle, Wash., plans the construction of a pulp and paper mill at Boston Harbor, 8 mi. from here. The first unit will consist of sulphate and soda pulp plant and sawmill. Estimated cost $750,000.

Wash., Tumwater — Tumwater Paper Mills, is having plans prepared for the construction of a 2 story, 78 x 320 ft. paper mill. Estimated cost $600,000. L. A. DeGuere, 262 Grand Ave., Grand Rapids, Wis., is engineer. Pipe machines, heaters, etc. will be required.

Canada

Ont., Kapuskasing—Spruce Falls Pulp & Paper Co., 300 Bay St., Toronto, awarded contract for the construction of a newsprint, sulphate and groundwood pulp mill, also a dam, power house, etc. on the Mattagami River at Smoky Falls to develop 50,000 hp., and 80 mi. transmission line from Smoky Falls to Kapuskasing to Morrow & Beatty Ltd., 442½ George St., Peterborough. Estimated cost, approximately, $12,000,000. Pulp and paper mill grinders, newsprint machines, motors, pumps, rolls, driers, etc. will be installed.

Ont., London—Bd. of Education, A. R. Cairncross, Chn., will soon award contract for the construction of a 2 story, 185 x 200 ft. high school including physics and chemistry laboratories, etc. Estimated cost $200,000. L. E. Carrothers, c/o owner, is architect.

Ont., London—Hygrade Corrugated Products Ltd., C. Munce, Mgr., 699 Bathurst St., awarded contract for the construction of a 1 story, 135 x 210 ft. factory to S. Foxworthy, 616 Waterloo St. Estimated cost $85,000. Owner is in the market for special machinery for the manufacture and cutting of paper, cardboard, etc.

Ont., Ottawa—Dept. of Public Works, awarded contract for the construction of a laboratory for Research Service to A. I. Garvock, Regent Theatre Bldg. Estimated cost $91,000. Complete laboratory equipment will be required.

Ont., St. George—Malcolm Condensing Co., manufacturers of condensed milk etc. plans to rebuild plant destroyed by fire. Loss is estimated at $85,000. Complete equipment will be required.

Ont., Toronto—Crosse & Blackwell Canada Ltd., H. P. Menzies, Managing Dir., 43 Front St. E., has acquired a 3 acre site and plans the construction of a jam and pickle factory at Fleet and Bathurst Sts. Estimated cost $1,000,000. Chapman & Oxley, Managing Dir., Northern Ontario Bldg., are architects. Engineer not selected.

Que., Aylmer—International Paper Co., Three Rivers, plans the construction of a paper mill here. Estimated cost $1,000,000.

Que., Quebec City—Anglo-Canadian Pulp & Paper Co., awarded contract for the construction of a paper mill including 126 x 234 ft. grinder room, 36 x 72 ft. finishing room, 72 x 235 ft. mixing room, etc. to W. I. Bishop, Ltd, 10 Cathcart St., Montreal. Estimated cost $15,000,000.